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F-16 LOW ALTITUDE NAVIGATION AND TARGETING INFRARED SYSTEM FOR NIGHT (LANTIRN) AND THE NIGHT CLOSE AIR SUPPORT (CAS) MISSION

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE

by

MICHAEL W. PALMER, MAJ, USAF
B.S., San Jose State University, 1975

Fort Leavenworth, Kansas
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19. ABSTRACT (con't)

This study examines the capabilities and limitations of the F-16 Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) to perform the night Close Air Support mission in Central Europe. The study examines the needs of the ground force commander for close air support in the night battle, assesses the threat posed by the Soviet integrated air defense systems, and measures the capabilities and limitations of the F-16 LANTIRN performing the night ground attack role. It applies those night ground attack capabilities to the specific requirements of close air support and makes a recommendation based on the analysis of employment effectiveness.

This study reveals that the need for night close air support is real. The LANTIRN system gives the F-16 pilot a new, survivable, night, low altitude attack capability in the Central European threat environment. But the unique mission requirements to effectively conduct air attack in support of troops-in-contact at night are not adequately met by this weapon system.

Keywords: Jet fighters, Forward looking Infrared systems, Infrared detectors, (SIRW)

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ABSTRACT

F-16 LANTIRN AND THE NIGHT CAS MISSION
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This study examines the capabilities and limitations of the F-16 Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) to perform the night Close Air Support (CAS) mission in Central Europe. The study examines the needs of the ground force commander for close air support in the night battle, assesses the threat posed by the Soviet integrated air defense systems, and measures the capabilities and limitations of the F-16 LANTIRN performing the night ground attack role. It applies those night ground attack capabilities to the specific requirements of close air support and makes a recommendation based on the analysis of employment effectiveness.

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INTRODUCTION

The night capabilities of the F-16 multirole fighter aircraft have been dramatically increased by the introduction of the Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN). The LANTIRN attack system gives the F-16 a capability to fly at night at very low altitude and attack ground targets with increased targeting and weapons employment options. This capability gives tactical air forces an advantage in conducting night ground attack missions which are not possible for aircraft weapon systems without LANTIRN.

Consequently, missions that the F-16 was not particularly adapted to in the past should be readdressed to assess the Air Force's overall night fighting capability and employment tactics. The significant effect that this weapon system could have on the future night battle requires this re-examination.

One mission that the F-16 LANTIRN has been considered for employment is the night close air support (CAS) mission. Traditionally a mission that is not recommended for the F-16 in a high threat environment at night, the proposed night capabilities of the F-16 LANTIRN

have now brought commanders to consider its employment in this role.

Capabilities of the F-16 LANTIRN could have particular significance in the Central European theater. The density of the Soviet integrated air defense system in Central Europe is the most formidable threat presented to tactical air forces throughout the world. However, the LANTIRN system was designed to give a tactical fighter the ability to fly at high speeds and low altitude at night and provide a reasonable chance to survive while conducting ground attack missions in spite of just such a threat. This night capability could dramatically change the shape of offensive air operations in Central Europe.

But, before any weapon system is assigned a mission in a particular theater of war, commanders must consider the issues that may spell success or failure of that weapon system in that mission. The limited number of tactical air assets in any theater of operations demands it. This thesis will attempt to address those issues.

THESIS QUESTION

Should the F-16 LANTIRN be assigned the CAS mission at night in Central Europe?

In considering the F-16 for the CAS mission at night in Central Europe, several questions arise. First, does the ground forces commander have a real need for close air support during the night battle? Secondly, does the F-16 LANTIRN have a real capability to survive the air defense threat it faces in the close battle at night? Third, what are the specific capabilities and limitations of the F-16 LANTIRN night ground attack? And finally, are the specific requirements unique to close air support met by the night ground attack profile of the F-16 LANTIRN?

It is my position that although the requirement for night CAS is real and the F-16 LANTIRN has a significant capability to survive and conduct night ground attack, the unique requirements for a successful close air support mission at night are not properly met by the F-16 LANTIRN weapon system.

NIGHT BATTLE

Today's technologies produce extremely capable thermal imagery equipment and night vision devices. These capabilities make the possibility of a full scale night battle a reality. No longer can combat forces rely on darkness for concealment and a possible break in combat operations.

Soviet application of these technologies is showing

increased emphasis as evidenced in their continued procurement of night capable equipment and development of offensive attack operations during night exercises. In the last decade, Soviet ground forces have trained for the full spectrum of night operations.<1> Night exercises consist of attack scenarios with the full integration of ground maneuver armor, motorized rifle units, artillery, engineer and other combat support forces. Soviet doctrine stresses the importance of night engagements as one of the key ingredients for achieving victory in the next war.<2>

NATO and US Army forces also plan to maintain a twenty-four hour battle capability in any future conflict. US Army AirLand Battle doctrine clearly defines this intent. Commanders of US Army forces increasingly stress a night-battle capability in training, exercises, and weapons procurement. NATO ground forces have also put greater emphasis on the night battle by incorporating night vision devices and night tactics into their training exercises.<3>

With the increased emphasis to integrate all forces in the night battle, commanders must consider every possible asset and mission that could be effectively applied to that environment. This could include additional air assets such as night-capable attack helicopters. However, this thesis will limit its scope to the application of the F-16 LANTIRN in support of ground forces in the Central European theater.

BACKGROUND

The requirement for the LANTIRN system is based on the recognized need for an effective night, low altitude, below-the-weather attack system. There are considerable limitations to the current capability to conduct ground attack operations in other than day, visual weather conditions. Current night and in-the-weather capabilities require highly specialized aircraft such as the F-111. The F-111 demonstrates a credible night attack capability, however, their numbers are relatively limited and they require dedicated training to employ effectively.<4>

Other tactical fighters require flares and clear weather to illuminate the target area for night attack. This tactic is generally ineffective and totally inappropriate for a high threat area such as Central Europe, where high speed and low flight is necessary to penetrate the Soviet integrated air defense threat.

The LANTIRN system is designed to allow the pilot to use the same flying techniques and tactics that he has learned and practiced during the day while operating at night.<5> In other words, pilots fly and attack targets using visual reference to the outside environment instead of using cockpit instruments with little or no use of outside references.

The objective of the LANTIRN system is to deny the enemy a sanctuary at night to conduct combat operations and to expand the fighter operations envelope beyond primarily daylight visual weather conditions. It does this by providing increased tactical fighter survivability due to a visual night low altitude capability. Current plans by the US Air Force are to equip 300 F-16C/Ds and 392 F-15Es with the LANTIRN system.<6> The first operational capability is planned for late 1989. First use of the F-16 LANTIRN in Europe is forecast for Fall 1990.<7>

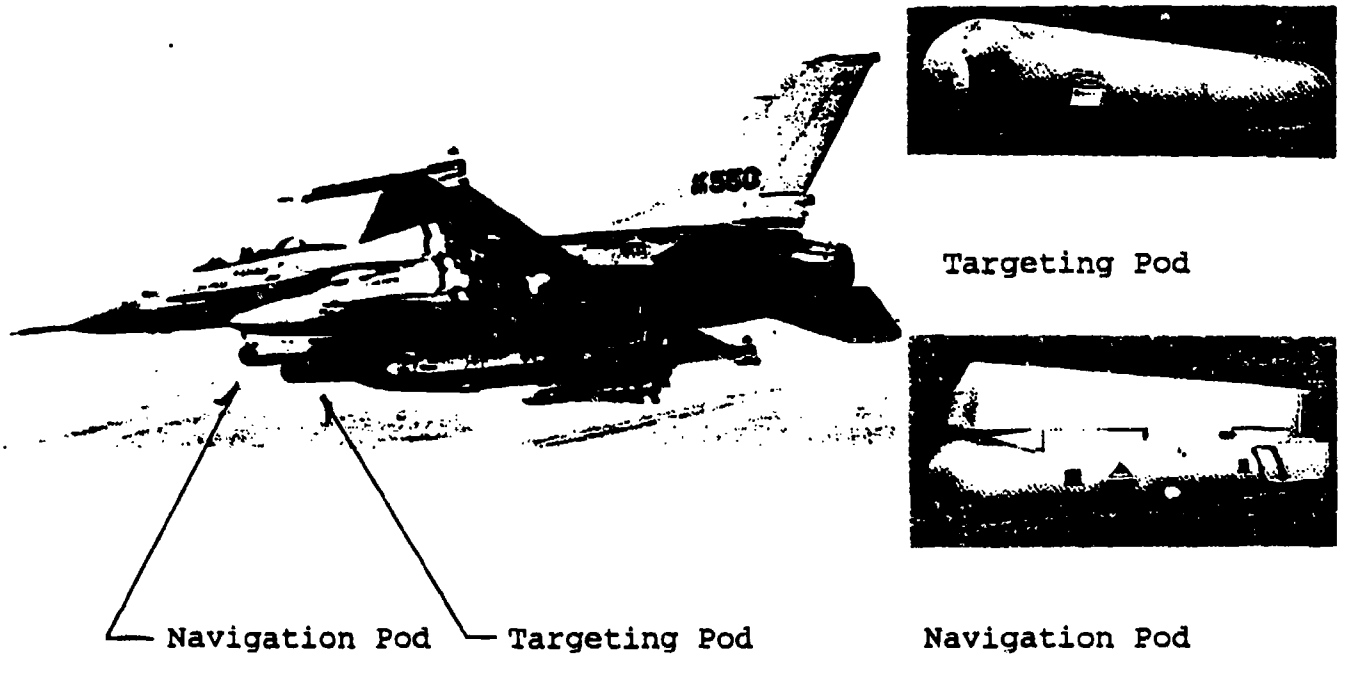

Figure 1-1. <8>

The LANTIRN system includes a navigation pod, a targeting pod, and a special wide field-of-view Heads Up Display (HUD). In a twin pod configuration, the navigation and targeting pod are externally mounted on the left and right side respectively of the engine inlet nacelle. See Figure 1-1.

The navigation pod provides a night low altitude flight and limited target attack capability. It includes a Forward Looking Infrared (FLIR) sensor package that presents a real-time one-to-one picture of the world on the wide field-of-view HUD. The targeting pod is integrated with the aircraft's fire control system and provides an increased range target acquisition and precision attack capability. It has a FLIR sensor that provides a limited field-of-view magnified video of normally a preplanned target area.<9> The video presented by the targeting pod is similar to looking through a telescope, the image is greatly magnified and the area of coverage is significantly reduced.

The Tactical Air Forces system operational requirements document (SORD) for LANTIRN states that LANTIRN equipped aircraft will be employed in surface attack across the spectrum of ground attack missions. Typical missions will be close air support (CAS), air operations that support Army ground units by attacking targets in close proximity to friendly forces; air interdiction (AI), air operations

conducted to delay, disrupt, divert, or destroy an enemy's military potential before it can be brought to bear against friendly forces; battlefield air interdiction (BAI), which is part of the AI campaign and includes attacks against targets in a position to have a near term effect on friendly ground forces; and counter air (CA), air operations directed against the enemy's air capability in order to attain and maintain a desired degree of air superiority.<10>

Tactical Air Forces have further defined the specific employment considerations for the F-15E and F-16C/D LANTIRN aircraft in its concept of operations. Both aircraft will be considered for the ground attack missions of air interdiction, offensive counter air and suppression of enemy air defenses (SEAD). However, the concept of operations further states that, of the two LANTIRN aircraft, only the F-16 will be considered for the CAS mission.<11>

Current employment of the F-16 (without LANTIRN) in the Central European area does not include CAS as a primary mission. Major John F. Miller, in a 1982 student thesis "The F-16 in Offensive Air Support," shares this position in his argument that employment of the F-16 in the BAI mission was more combat effective than in the CAS role, especially in an extremely dense threat environment.<12> In addition, current tactical doctrine for employment of the F-16 does not recommend high threat night close air support. This

doctrine, which does not address LANTIRN, states that "due to low probability of mission success and high risks involved, high threat night CAS is not recommended for the F-16." <13>

The question that must be answered is whether the addition of the LANTIRN attack system gives the F-16 the capability to effectively conduct ground attack, survive and meet the unique requirements of the CAS mission in the high threat Central European theater.

THESIS PURPOSE

This thesis evaluates the F-16 LANTIRN capability to accomplish the close air support mission at night in Central Europe. The purpose of the study is to recommend whether or not commanders should assign the F-16 LANTIRN the night CAS mission.

In order to arrive at a recommendation, this thesis will study the needs of the ground force commander for close air support in the night battle. It will assess the Soviet integrated air defense threat capability on the night battlefield and the ability of the F-16 LANTIRN to survive that threat. A close look will be made of the capabilities and limitations of the F-16 LANTIRN in the night ground attack role, and how effectively that ground attack capability can be applied to the requirements of the night

CAS mission. These issues will be combined to make a final recommendation of whether this weapon system should be assigned the night CAS mission in Central Europe.

ASSUMPTIONS

Due to the documented Tactical Air Forces concept of operations that includes the night close air support mission, this thesis will assume that consideration is being given for F-16 LANTIRN employment in the night CAS role.

Tactical Air (TACAIR) assets are limited in number and cannot fill all the mission and specialized task requirements in any one theater of operations. It is assumed that studies and subsequent recommendations will be considered when deciding how best to apply the limited number of air assets to the battlefield.

LIMITATIONS

This thesis will remain unclassified in order to receive the widest dissemination.

Major avionics upgrades on the F-16 are identified by block number. The first upgrade version which will incorporate the LANTIRN night attack system is Block 40. The Block 40 F-16C/D will be used as the baseline aircraft for this study. Only the current conventional weapons programmed for certification on the Block 40 F-16C/D will

be considered in the discussion.

The study will consider the application of the F-16 LANTIRN to a doctrinal Soviet integrated air defense threat. It will be based on a threat array that could be encountered in Central Europe if laid out according to Soviet doctrine. To keep this writing unclassified, it will not identify a specific location or known threat array in Central Europe.

DELIMITATIONS

This thesis will not address the considerations or recommendations for the employment of the F-16 LANTIRN outside the Central European theater.

At the time of this writing, the Air Force is proposing a dedicated CAS version of the F-16 as a follow-on to the A-10. This proposed variant, identified as an A-16, will add specialized systems to the current F-16 airframe in order to optimize its employment in CAS as a primary mission.<14> Although the A-16 proposal includes aspects of the LANTIRN system, conclusions and recommendations in this thesis will not apply to its employment. The unique capabilities of the A-16 and recommendations for its employment will be left to subsequent studies.

SIGNIFICANCE

Providing effective air support to the ground force

commander may well shape the final outcome of a future battle. The capability of the F-16 LANTIRN to conduct the night close air support mission in a timely and effective manner must be determined. A careful study of the ground force commander's needs and the capability of the F-16 LANTIRN to meet those needs may have significant impact on the shape of the night battlefield.

METHOD OF STUDY

The methodology followed in this study attempts to consider those aspects of employing the F-16 LANTIRN that directly relate to the effectiveness of accomplishing the night CAS mission. The four major areas that will be studied are the air support needs of the ground forces at night, the threat environment, F-16 LANTIRN ground attack capabilities and limitations, and specific requirements of the night CAS mission.

Chapter 2 will study the ground force commander's requirement for offensive air support. The relative importance of the CAS mission in overall support of the night battle will be identified and assessed.

Chapter 3 will look at the threat the F-16 LANTIRN will face in the Central European theater. A review will be made of the seasonal weather conditions, the variations in length of day/night cycles in Europe, and the Soviet

integrated air defense threat presented at night. The night "window of opportunity" to conduct close air support will be summarized.

Chapter 4 will identify the specific capabilities and limitations of the F-16 LANTIRN ground attack. Low-level flight, attack profiles, target acquisition and weapons delivery capabilities will be assessed in the basic night ground attack role.

Chapter 5 will examine the specific requirements of the night close air support mission. Emphasis will be placed on the capability of the F-16 LANTIRN pilot to meet those requirements and the ground force commander's ability to effectively use this weapon system in the night CAS role.

The final chapter will summarize the issues and present a recommendation of whether F-16 LANTIRN employment in Central Europe should include the close air support mission at night. It will conclude with a look at future proposals for F-16 LANTIRN upgrade and give recommendations for additional study.

Finally, the summaries and conclusions in this study are my own. They come from a pilot who has flown the F-16 in Central Europe and can appreciate the complexity and demands of the mission in question.

DEFINITIONS OF TERMS

Air Defense - All measures designated to nullify or reduce the effectiveness of an enemy attack by aircraft or guided missiles in flight.

Air Interdiction (AI) - Air operations conducted to destroy, neutralize, or delay the enemy's military potential before it can be brought to bear effectively against friendly forces. These missions are conducted at such distances from friendly forces that detailed integration of of each air mission with the fire and movement of friendly forces is not required.

Air Liaison Officer (ALO) - The senior Air Force officer at each tactical air control party (TACP). Advises the Army commander and staff on the capabilities, limitations, and employment of tactical air operations.

Battlefield Air Interdiction (BAI) - Air operations conducted to destroy, neutralize, or delay the enemy's military potential that has a near-term effect on the operations or scheme of maneuver of friendly forces, but are not in close proximity to friendly forces. BAI attacks require joint coordination at the component level during planning and may require coordination during execution.

Close Air Support (CAS) - Air action against hostile targets in such close proximity to friendly forces that detailed integration of each air mission with the fire and movement of those forces is required. Integration is accomplished through parallel air and ground force control systems that extend through all echelons of command.

Combat Support - Fire support and operational assistance provided to combat elements. Includes artillery, air defense artillery, engineer, military police, signal, military intelligence, and chemical.

Command and Control - The exercise of command that is the process through which the activities of military forces are directed, coordinated, and controlled to accomplish the mission.

Communications Jamming - Electronic measures taken to deny the use of communications means.

Defensive Counter Air (DCA) - Air operations to destroy enemy air vehicles attempting to penetrate friendly airspace.

Electronic Countermeasures (ECM) - Actions taken to prevent or reduce the enemy's effective use of the electromagnetic spectrum. Includes jamming and electronic deception.

Electronic Warfare (EW) - The use of electromagnetic energy to determine, exploit, reduce, or prevent hostile use of the electromagnetic spectrum and to ensure friendly use thereof.

Fire Support - Assistance to those elements of the ground forces which close with the enemy such as infantry and armor units, rendered by delivering artillery and mortar fire, naval gun fire, and close air support (CAS).

Fire Support Coordination Line (FSCL) - A line established by the appropriate ground commander to ensure coordination of fire not under his control but which may affect current tactical operations.

Forward Air Controller (FAC) - A member of the tactical air control party (TACP) who, from a ground or airborne position, controls aircraft engaged in close air support (CAS) of ground forces.

Forward Edge of the Battle Area (FEBA) - The forward limit of the main battle area (MBA).

Forward Line of Own Troops (FLOT) - A line that indicates the most forward positions of friendly forces in any kind of military operation at a specific time.

Head Up Display (HUD) - A device mounted on top of the instrument panel that displays instrument readings, navigation, and weapon delivery information to the pilot. It allows the pilot to view this information while at the same time observing the outside world, reducing the requirement to look "inside" the cockpit during critical phases of flight.

Immediate Mission Request - A request for an airstrike or reconnaissance mission that by its nature could not be identified sufficiently in advance to permit detailed mission consideration and planning.

Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) - an effective night, under-the-weather, low-level navigation and ground attack system.

Jamming - The deliberate radiation, reradiation, or reflection of electromagnetic energy to prevent or degrade the receipt of information by a receiver.

Lines of Communication (LOC) - All the routes that connect an operating military force with one or more bases of operations and along which supplies and military forces move.

Mutual Support - Support that units render to each other against an enemy because of their assigned tasks, relative positions, and their inherent capabilities.

Offensive Air Support (OAS) - That part of tactical air support of land operations that consists of tactical air reconnaissance, battlefield air interdiction (BAI), and close air support (CAS), which are conducted in direct support of land operations. (Used in NATO only.)

Offensive Counter Air (OCA) - Air operations normally conducted throughout enemy territory to seek out and destroy aircraft, air bases, air control systems, fuel stores, and other elements which constitute or support the enemy air order of battle.

Pop-Up Point (PUP) - The location at which aircraft quickly gain altitude for target acquisition and engagement.

Preplanned Mission Request - A request for air support that is submitted in compliance with a schedule that permits detailed mission coordination and planning.

Sortie - One aircraft making one takeoff and one landing. An operational flight by one aircraft.

Suppression of Enemy Air Defenses (SEAD) - That activity that neutralizes, destroys, or temporarily degrades enemy air defense systems in a specific area by physical attack and/or electronic warfare (EW) to enable tactical air operations to be successfully conducted.

TACAIR - A general term applied to all tactical fighter aircraft used in support of the ground battle. It may include air-to-air or air-to-surface aircraft.

CHAPTER 1

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CHAPTER 2

NIGHT CAS REQUIREMENT

Before making a recommendation of whether the F-16 LANTIRN should be assigned the night CAS mission, a clear understanding of the ground force commander's needs for close air support in the night battle is required. In addition, reviewing the total offensive tactical air support provided to the ground force commander will help identify any requirements that can only be met by a night CAS capability.

This chapter will define and characterize those missions designed to directly support ground forces. It will describe the enemy night battle according to Soviet doctrine, the conduct of the US/NATO ground forces' response to that threat and how each of the offensive air missions can support the ground force commander.

Tactical air support of ground forces in Europe is described in NATO Allied Tactical Publication (ATP) 27(B), Offensive Air Support Operations. ATP-27(B) defines Offensive Air Support (OAS) as that part of tactical air support of land operations that consists of Tactical Air Reconnaissance (TAR), Battlefield Air Interdiction (BAI), and Close Air Support (CAS).<1> Tactical Air Reconnaissance

will not be addressed because it is not a variable in this thesis. However, a close look at the two primary tactical air missions providing direct fire support to ground forces is required.

Close air support is defined as air action against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces.<2> Close air support operations are conducted to blunt enemy attack on friendly positions, help ground forces obtain and maintain the offensive, and provide cover for friendly movements.<3>

Battlefield air interdiction is defined as air attacks against targets in a position to have a near term effect on friendly land forces. It requires joint planning and coordination between Army and Air Force units at the component level, but, then it is controlled and executed as an integral part of the air commanders total air interdiction campaign.<4> Depending on the nature of the ground situation, it may not be necessary to integrate each mission with the fire and movement of friendly forces and, therefore, not require continuous coordination during the execution phase.<5>

A key issue in the differentiation of CAS and BAI is

the definition of "close proximity" to friendly forces. Nowhere in Army or Air Force doctrine is this term specifically defined in terms of distances between targets and friendly forces or in terms of air attack control requirements.

Although close air support can cover a wide spectrum of operations, CAS is most often associated with the classic troops-in-contact (TIC) situation.<6> For this study, an air attack which is close enough to friendly forces that it would be a threat to those forces without direct or procedural control by a ground force agency during execution will be considered a CAS mission. Conversely, an air attack that is far enough from friendly positions that it can be executed under the control of the aircraft pilot or flight leader will be considered eligible for the BAI mission.

The relationship between the interdiction of follow-on enemy echelons by BAI and the air attacks of CAS is inseparable. Together these missions attempt to insure that the friendly to enemy ground force ratio favors the friendly forces at the point of contact.<7> To coordinate these two missions and to facilitate joint planning, two planning lines are used for the integration of air to ground weapon systems. These are the Forward Line of Own Troops (FLOT) and the Fire Support Coordination Line (FSCL).

The FLOT is a line indicating the most forward positions of friendly forces in any kind of military operation at a specific time. The FSCL is a line established by the appropriate ground forces commander to ensure coordination of fire not under his control but which may affect current theater operations. Supporting attacks up to this line must be coordinated with the appropriate ground force commander. Supporting attacks beyond this line do not require prior coordination.<8>

In general, CAS is normally planned against targets that are in close proximity to friendly troops and which are located short of the FSCL. BAI targets are found on either side of the FSCL but are not in close proximity to friendly forces.<9> The key differences are that CAS requires integration and direct or procedural control by ground forces during the execution phase. BAI is conducted under flight lead control. Both missions, however, are in direct response to the needs of the ground force commander. Now let's look at the specific support requirements that each of these missions provide and see how they fit into the night battle.

CLOSE AIR SUPPORT

The inherent mobility and firepower of close air support can have an immediate and direct impact on the land

battle. Close air support can make a decisive contribution to the firepower of surface forces during offensive breakthroughs, counterattacks, enemy surprise attacks and assaults. It may not be possible to attain the desired concentration of firepower without the combined action of ground based fire support weapons and close air support aircraft.<10>

The ground force commander has a timely and responsive means of applying air delivered fire power with CAS. His needs on a fluid and ever changing battlefield can be significantly aided by the immediate and direct input he has when applying CAS. CAS can surprise the enemy and create opportunities for the maneuver or advance of friendly forces through shock action and concentrated attacks. It can protect the flanks of friendly forces or blunt enemy attacks and counteroffensives and it can also protect the rear of land forces during retrograde operations.<11>

Close air support enhances land force operations by providing the capability to deliver a wide range of weapons and massed firepower at decisive points. Surface force fire support systems plan and use CAS assets when other fire support means are not available, appropriate, or when the decisive application of massing firepower is required.<12> When the targets in an area are not accessible or vulnerable to surface-based weapons, they may be within the attack

capability of CAS aircraft.<13> The application of CAS aircraft to the battlefield gives the ground force commander an added extension to his fire support capability.

CAS requests may originate from any level of command within the ground forces. The sorties that are allocated to CAS may be used for preplanned attacks when targets or target areas are known. The advantages of preplanned requests are the opportunity for aircrews to complete detailed mission planning and target area study and also the opportunity for the best suited ordnance to be loaded for the mission.<14>

Some of the sorties may be held in reserve and placed on an alert status to fill immediate CAS requirements when specific targets and locations are not already known. Immediate request sorties may be used to quickly reinforce a defense or may help exploit an opportunity created by a friendly advance. Immediate request aircraft may be on ground or airborne alert. Airborne alert aids in response time but may require air refueling and preplanned back-up targets to ensure effectiveness of the sorties.<15> Alert sorties allow little or no preplanning, only airborne target briefings and are limited to the ordnance loaded prior to the request. Preplanned and immediate requests attempt to fill the ground forces requirements for air support whenever targets are identified.

Close air support can be flown against a variety of targets which pose a threat or obstacle to planned or current operations. Almost any threat that is found on the modern battlefield can be targeted by CAS aircraft. Close air support is not specifically adapted to any single category of target, but mobile targets in general present the greatest threat to surface forces and are prime targets for consideration.<16> Typical targets for close air support could be enemy troop concentrations, mechanized or mobile maneuver elements or fire support assets.<17>

Control of CAS aircraft is conducted by a Forward Air Controller (FAC). The FAC is a fighter knowledgeable aircrew specifically assigned and trained to coordinate and control air support sorties. The FAC integrates the air attacks with the fire and maneuver of supported ground forces. His duties may be conducted from ground or airborne positions. He controls strike aircraft from a contact point to the target or weapons release point.<18>

The typical CAS profile starts when the fighters contact the FAC at a holding or rendezvous point. The FAC will be in contact with the ground forces to determine friendly positions and target location. He will also coordinate defense suppression, tactical fire, ground laser or other target designation and friendly air defense with the ground commander. The FAC then passes the required

attack information on to the CAS aircraft, describes or designates the target or target area and clears the fighters to employ their ordnance.<19> As can be seen, the ability of the ground force commander to mass firepower at the decisive point on the battlefield with a close air support capability can be a significant asset.

As air defense threats increase, the employment of CAS is often visualized at the forward edge of the battle area using stand-off weapons that attempt to stiff arm potential air threats. This leads to a view that the ideal CAS profile is one that makes multiple attack passes, each pass delivering ordnance at maximum range. However, the probability that forces will be operating deeper into enemy territory in fluid situations with loosely defined front lines means that aircraft may have to penetrate enemy defenses to get to where they have to conduct close air support.<20>

Although a significant amount of air support may be required in the main battle area, it does not mean that CAS is not required throughout the depth of the battlefield. CAS can be particularly important to offset the shortages of surface firepower during critical stages of airborne and airmobile operations.<21> CAS operations may be needed where penetration of enemy air defenses is required or where stand off from enemy defenses is not an option.

BATTLEFIELD AIR INTERDICTION

With a basic understanding of how close air support assets can be employed, a brief comparison can be made with BAI, the other offensive air support mission available to the ground force commander. Reviewing the capabilities of BAI can highlight the relative importance of CAS to the ground force commander's overall air support requirements.

The Soviet concept for employment of armored forces calls for echelons in depth directed at a narrow section of friendly defenses to apply relentless force, cause a breakthrough and then with the follow-on echelons exploit the penetration.<22> Battlefield air interdiction (BAI) is employed to disrupt that continuity of the enemy's operations by attacking in the deep arena of the ground forces battlefield. The objectives of the ground force commander by employing BAI are threefold: first, reduce the enemies capability to employ follow-on forces; second, prevent the enemy from countering friendly maneuver; and third, reduce the enemy's capability to resupply his committed forces.<23>

Normally, a minimum of 24 hours advance planning is required for ground forces to nominate BAI targets. The target nominations are passed up through corps, consolidated by priority and submitted to the air commander in accordance

with the established tactical air operations planning cycle. The cycle may vary form 8 to 36 hours to allow for weapon selection, attack planning and possible air refueling, defense suppression and fighter escort coordination. Refinement of target information and continuous intelligence sharing is conducted between Air Force and Army corps planning cells.<24>

BAI missions are coordinated during joint planning. Depending on the nature of the ground situation, the detailed integration of each air interdiction mission with the fire and movement of friendly ground forces is not normally required.<25> This is because BAI strikes by definition are not conducted in close proximity to friendly forces, but, against targets that are in a position to have a future near-term effect on those forces. If BAI designated targets maneuver to close proximity of friendly positions, CAS control procedures are then required.

When a target is assigned to a BAI mission, it is best to designate a target result or objective. This allows the air commander to select the proper tactic and weapon system to attain the desired results. BAI targets of concern are second echelon troop and armored units, built-up industrial areas, supply and transportation elements, command and control complexes, lines of communication, troop staging areas and weapon system repair centers.<26>

Targeting for BAI missions is especially valuable at the outbreak of hostilities and during circumstances when friendly communication systems are ineffective.

MISSION COMPARISON

The basic difference between CAS and BAI is the proximity of targets to friendly troops and the control procedure therefore required. Both missions are in support of the ground force commander directed against targets that threaten the ground force operations. CAS requires control inputs and integration with the fire and movement of friendly forces. BAI requires fire coordination only if the target is short of the FSCL which is usually accomplished during the joint planning phase.<27> The CAS mission requirement will be directly influenced by the effectiveness of the BAI campaign. As enemy forces pass through the BAI area of operations they transition to the responsibility met by close air support. BAI against echeloned forces must be closely integrated and may be inseparable from the CAS effort.<28>

In order to be responsive to the ground force commander's needs, allocation options should be planned to be interchangeable between CAS and BAI. The option that is selected will depend on the battlefield situation and the tactical objectives to be achieved.<29> When friendly

forces are expected to be operating in the vicinity of the target area, CAS procedures should be put into effect. If not in the vicinity, then BAI aircraft can be employed.

> The deeply echeloned soviet forces tend to reduce the distinction between interdiction and close air support. To stop the advance of these echelon attacks, air support is needed from the point of contact to the depth of the enemy thrust directed at friendly positions.
>
> TACM 2-1 <30>

SOVIET NIGHT BATTLE

The Soviet night battle, like every Soviet battle, is based on a combined-arms concept. This concept is at the center of all Soviet doctrine. It attempts to employ maneuver to apply force in the "indirect approach," attacking with strength at the enemy's weak points, thereby avoiding the drawn out static line and slow paced battle.<31> The basic tenant of combined-arms combat is to attack an enemy with a wide variety of weapons. The theory is that actions taken to avoid one threat will make the opponent vulnerable to another.

Soviet combined-arms battle places total emphasis on the offense. The defense is seen merely as preparation for subsequent offensive operations. surprise, shock and exploitation are emphasized throughout the depth of the battlefield in order to create havoc and break down

continuity and cohesion of the opposing forces.<32>

Soviet doctrine characterizes the combined-arms offense through a variety of related actions. Breakthroughs are created by ceaseless firepower and armor assaults accompanied by overwhelming air support. Forces are echeloned in depth applying constant pressure to create and exploit the breakthroughs. Penetrating into the enemy rear, units can maneuver, encircle main forces, exploit and break down enemy command, control and logistics. Offensive ctions are seen as high tempo operations using maximum rates of advance on multiple axes. Soviets believe a high degree of central control and close timing of echeloned forces will insure momentum.<33>

Soviet doctrine states that an attack which has begun must be developed continuously, day or night, in any weather right up until its ultimate goals have been obtained.<34> It also states that by skillfully employing the advantages offered by night conditions, attacking and defending units can fulfill their missions with fewer losses in personnel and equipment. They believe that night favors march, infiltration and maneuver. They feel it is easier to concentrate at the decisive point and that darkness hampers the enemy's use of most weapons, aviation and airborne troops. Soviets believe night provides the most favorable conditions for surprise. The conduct of night operations is

considered to be only a part of a continuous effort.<35>

The night attack may be a continuation of a daytime offensive or it may be the initiation of a major offensive which is started prior to daylight. The night attack which is a continuation offensive is carried through without a break in tempo so the defender has no time to regroup or bring up reserves. A night attack started 2 to 3 hours prior to daylight may be initiated to achieve a limited objective such as breaching an enemy defense.<36>

The unit preferred by the Soviets for the night attack is the reinforced motorized rifle battalion. The battalion would typically be reinforced with a battalion of artillery and a company of tanks. The normal night mission would be to penetrate enemy defenses as rapidly as possible to create confusion and allow exploitation by larger units. A tank battalion could also be employed in a night attack since they have the advantage of built-in night vision devices, on-board navigation equipment and spotlight illumination aids. Armor units would normally perform the night attack accompanied by infantry either dismounted or in armored fighting vehicles. Another Soviet technique is to employ a combined-arms force conducting multiple battalion attacks. Using tank and motorized rifle task forces gives the complimentary effects of mounted or dismounted infantry and the firepower of armor to assault enemy positions.<37>

We would expect Soviets to conduct night defensive operations in much the same manner as during the day. However, operations could vary to take advantage of or decrease the limitations of specific weapon systems. Weapons that have night vision or thermal imagery capabilities would most likely be moved forward. We could also expect that reserve and reinforcement forces may be moved to a more forward position to reduce the distance of travel at night if committed.<38>

Soviets acknowledge that effective command and control of night operations are both essential and complicated. Their night operations are therefore characterized by extensive planning and preparation. Careful reconnaissance of specific routes and subsequent rehearsals in daytime are considered key to success at night. Any counterattack, whether from air or ground forces, which could delay or disrupt that plan could have a significant effect on the success of Soviet night operations.<39>

US/NATO NIGHT BATTLE

The dynamics of combat power may decide the outcome of a campaign, major operation, battle or engagement. Leaders create combat power by combining maneuver, fire power and protection and applying it in combat against an enemy.

Leaders also attempt to interfere with the enemy's ability to effectively maneuver, apply firepower, or provide protection.<40> Offensive air support is one significant arm of combat power available to the ground commander that could be the potential element to decide the outcome of the night battle.

Airland battle asserts that, whether attacking or defending, success depends on securing the initiative as early as possible and exercising it aggressively. It requires that every weapon, asset, and combat multiplier be used to gain the initiative, to throw the enemy off balance with a powerful blow from an unexpected direction, and to follow up rapidly to prevent his recovery.<41> A night offensive air support capability could be the significant combat asset in gaining the initiative.

US/NATO ground forces are dedicated to the effective employment of forces in the night battle. Allied equipment with night vision or thermal imagery sights are becoming wide spread. Night vision devices are becoming less cumbersome, more powerful and require less ambient light than ever before. Thermal imagery devices can detect troops and vehicles in spite of camouflage, through obscurants such as smoke or fog, and in total darkness. Every M1 tank has a thermal imagery device. All M2/M3 infantry fighting vehicles and every TOW anti-tank weapon system have thermal

sights and more than 50% of Dragon anti-tank weapon trackers are thermal devices. In addition allied armies are equipping commanders down to platoon level with hand held thermal devices and a variety of much improved crew served night sights and night vision devices which are becoming even more wide spread.<42>

With the wide availability and use of night capable sights and vision devices, troops who prepare and develop a sense of self-confidence in the night environment become the night hunters instead of prey.<43> In the attack stealth, surprise and shock should be stressed. Although consideration must be given to the limitations of continuous operations, night operations can payoff with results that might have been gained at a much higher cost during the day.

As night sighting and thermal devices become more common, night offensive doctrine must consider the effect. Effective night air support is important in every phase of offensive operations throughout the depth of the battlefield. In order to achieve surprise, the ground commander attempts to strike at a time and place, or in a manner for which the enemy is unprepared. In the ground force's deep offensive operation, BAI is employed to delay, disrupt or destroy high payoff targets in the enemy rear. Offensive operations in the close area employ CAS in support of the committed maneuver units. CAS aircraft may also be

diverted against an enemy attack in the rear area.<44> The inherent flexibility and speed of offensive air support can significantly increase the shock action and effect of surprise in the night attack.

CAS may be used by a brigade offensive in a night attack for deep fires to defeat counter attack forces or defensive positions in depth. The responsiveness of CAS gives the ground commander the ability to hit counterattack forces on the move while they are in column formation. This employment of CAS allows the full concentration of field artillery and mortar concentrations to suppress direct and indirect fire weapons at the penetration point.<45>

Once the night attack penetration has succeeded and forces transition to exploitation and pursuit operations, CAS and BAI aircraft then concentrate on lines of withdrawal, columns and reserves. CAS may also be used against enemy forces that threaten the flanks of the exploiting force. All available means, including CAS, should be employed to confuse the enemy, to deny him the use of his command, control and communications and to hinder his attempts to consolidate and reorganize.<46>

Although priorities may change, CAS and BAI support for the ground forces defensive operations at night are identical to that required for offensive operations.<47>

Offensive air support makes some of its greatest contributions to the defensive night battle by disrupting enemy ground operations, particularly along the leading edge of combined arms attack thrusts. Air operations help to shatter the enemy cohesion and coordination and allow friendly ground forces to take up effective defensive positions.<48>

As with the offensive doctrine, defensive doctrine must also consider the capabilities of night vision and specifically thermal imagery devices in the conduct of the night battle. Attacker reconnaissance units employing night thermal imagery equipment will have the capability to readily observe front slope friendly positions. This gives the attacker the advantage of knowing the defenders positions at the start of the attack. The long range capability of Soviet direct fire weapons also give him an advantage to fire line-of-sight before NATO forces can. The result of this capability makes the reverse slope defense even more significant.<49> It also increases the importance of an effective direct fire offensive air support capability. CAS can be employed to increase firepower on attacking enemy units to disrupt enemy cohesion prior to coming into range of friendly force direct fire weapons.

CAS may also be allocated to augment the combat power of maneuver forces in the night defensive security

area. Security forces attempt to force the enemy to commit combat forces prior to attacking into the main defensive area.<50> CAS can aid in this operation and if employed early may be able to hit enemy forces in column formation on the move. BAI and CAS strikes can be applied against forces moving toward or away from the battle area or destroy enemy units before they can join or attempt to bypass friendly forces in an envelopment operation. BAI is applied against those forces in depth and CAS is used against those enemy forces that are in close proximity to friendly forces.

An ordnance that is extremely valuable in defensive operations and even some offensive operations is the family of scatterable mines (FASCAM). FASCAM provides a rapid and responsive obstacle emplacement capability to the ground force commander, especially at night.<51> The time required for enemy forces to clear a path through a minefield barrier increases at night by 1.5 to 2 times. The time to layout or prepare a new route increases by 1.3 to 1.5 times at night.<52> CAS and BAI can be employed to place air delivered FASCAM. This gives the ground force commander a very rapid means to channel and impede movement, create bottlenecks and increase exposure of enemy forces. It gives him the flexibility to rapidly place an effective obstacle if required on the changing night defensive battlefield.

In the defensive battle, the full range of air

support throughout the framework of the battlefield is increasingly significant at night. The added capability to apply direct fire support with CAS aircraft gives the ground force commander the ability to disrupt an enemy assault much earlier. Placing FASCAM both deep with BAI aircraft and close by ground directed CAS assets gives the ground commander a rapid obstacle and effective blocking capability. And, just as in the offensive battle, CAS can be rapidly diverted to the rear area to counter a significant enemy deep threat.

SUMMARY

Providing adequate air support to ground forces is a task to which TACAIR is dedicated. Offensive air support attempts to meet this task by assigning TACAIR assets the missions of close air support and battlefield air interdiction. Both CAS and BAI are employed against enemy forces where destruction or delay will result in the greatest potential to disrupt the enemy commander's plan or operational tempo.<53> Offensive air support provides the ground force commander an air arm with the capability to deliver a wide range of weapons and massed firepower at decisive points. Although the required control procedures are different, both CAS and BAI meet specific requirements to provide firepower throughout the depth of the ground force commander's battle. The combination of CAS and BAI

applies fire support pressure against enemy forces from the point of contact to the depth of the enemy thrust.

Soviet doctrine professes that the combined-arms offensive will consist of numerous attacks throughout the depth of the battlefield. Once these attacks have been initiated they will be developed continuously, day or night, until the ultimate goals have been attained. They believe that night operations lend themselves to surprise and shock action and that missions at night can be accomplished with fewer losses in personnel and equipment. Extensive preparation and planning are involved in Soviet night operations and the ability to disrupt that plan will be significant to any operation employed to counter Soviet forces at night.

The success of friendly night offensive and defensive operations may depend greatly on the the massing of airpower at decisive points. BAI can slow the tempo of reinforcement in the Soviet night offensive by operations that delay, disrupt or destroy follow-on forces in the deep battle area. CAS can enhance friendly ground force operations by creating opportunities to break through enemy lines, protect the flanks of a penetration or prevent countermeasures by the enemy surface force. CAS can protect friendly maneuver and assist in the fire support effort to defend ground forces. The needs of the ground force

commander for offensive air support at night can be met effectively only by the combined missions of BAI and CAS.

> Defense planners argue that TACAIR must be structured for an across the board capability. All TACAIR missions are important and it is impossible to predict when combatant commanders will need to emphasize one or all of them.<54>

Every Corps or Division commander, active or reserve, who has participated in the Battle Command Training Program at Fort Leavenworth in the last year has shown substantial interest in the air support that can be provided at night. Each of these commanders conceded that the night battle will be a significant factor in the next major conflict and have expressed real concern over the current lack of capability to effectively conduct close air support at night.<55>

If we do not demonstrate the ability to provide the full range of air support missions in the night battle, or if we choose to turn away from any of these missions, we can expect the Soviets to continue to emphasize and exploit the night environment.

CHAPTER 2

ENDNOTES

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CHAPTER 3

THE THREAT ENVIRONMENT

Now that a need for night CAS has been identified, the next area that must be addressed is the environment in Central Europe where the employment will take place. This chapter will identify the environment in terms of the hours of daylight and darkness, the low level weather trends and the Soviet air defense that opposes the employment of LANTIRN in Central Europe. By studying these areas a determination can be made about the window of opportunity to accomplish the night CAS mission.

HOURS OF DARKNESS

Due to the northern latitude of Central Europe, the length of the day or night varies significantly with the changing of seasons. The longest period of darkness in December in Central Europe is 17 hours. On the other side of the spectrum, the shortest night in June is 6 hours.<1> It is evident that restricting offensive air support operations to the hours of daylight, although not very significant in summer, would result in an extremely limited capability during the winter. The number of sorties that are limited to day only operations in winter can increase two to three times with a 24 hour operation capability.<2>

Since we are unable to forecast the season in which a Central European battle may take place, it is imperative that we be prepared for any.

WEATHER TRENDS

Flight operations that are conducted at low altitude below the clouds using visual references require visual meteorological conditions (VMC). VMC requirements are a minimum ceiling of 1,000 feet and a visibility of 3 miles. In Europe, daylight and VMC conditions exist on the average 12 hours in a 24 hour day in summer and only 4.5 hours in winter. However, with a LANTIRN capability including the hours of darkness, the operating hours that meet VMC increase to over 19 hours a day in summer and 14 hours in winter. This increases the window of opportunity to conduct low level flight operations by 60% in summer and 300% in winter.<3>

The current capability to conduct night operations using visual references without LANTIRN, as in dropping ordnance under flare illumination, requires a higher combination of ceiling and visibility than minimum VMC. However, weather trends in Central Europe rarely present the opportunity to conduct operations that require higher weather minimums. During the winter season low clouds and visibility are quite common. Ceilings of less than 2,000

feet and visibilities less than 6 miles occur 70 to 80 percent during the winter hours of darkness.<4> This presents little opportunity if any to conduct non-LANTIRN visual TACAIR operations due to weather alone.

In general, weather conditions are least favorable November through February and most favorable in May through September. However, in comparison of day and night, the more favorable conditions are most frequent at night and less frequent during daylight.<5> The combination of favorable ceiling and visibility is greatest in the afternoon through early evening up to midnight. However, the best conditions in winter may occur near midnight in some low-lying areas.<6>

With LANTIRN, attaining a capability to conduct offensive air support at low altitude at night increases the window of opportunity dramatically. During the worst seasonal weather, the operation envelope increases from 4.5 hours to more than 14 hours a day.<7> The capability to conduct night operations under a ceiling of 1,000 feet and 3 miles visibility can therefore increase the operations window over 300%.

THE AIR DEFENSE THREAT

The objective of the Soviet integrated air defense system (IADS) is to reduce the effectiveness of enemy air

attacks. The air defense of maneuver units is conducted in three phases. The first is actions taken to destroy enemy aircraft while they are still on the ground. The second is the destruction of aircraft while they are in flight but still at a distance from Soviet ground forces. The third is the destruction of enemy aircraft that have penetrated the airspace over ground maneuver forces. Soviet aviation resources conduct the majority of the operations in the first two phases of air defense. The third phase is the primary mission of the Soviet tactical air defense forces.<8> This study will orient primarily on the air defenses employed in the third phase and their effect on operations of the F-16 LANTIRN at night.

Soviet combat operations will normally take place within a theater of military operations or Russian TVD. Within the TVD, the operational forces are organized into fronts and armies. The primary air defense threat for the tactical fighter aircraft is from the front level down. A front is a combat formation which consists of several armies or separate divisions.<9> The armies are categorized as either combined arms armies (CAA) or tank armies (TA). Each Soviet army has a significant organic air defense capability with highly mobile and sophisticated surface-to-air missile (SAM) and gun systems.<10>

Soviet air defense weapons are assigned at army,

division, regiment, battalion and company level. The combined assets at all levels provide an air defense umbrella from approximately 30NM in front of the most forward units for medium to high altitude targets and about 4NM for low-level targets, to the rear areas of the army operations (See Figure 3-1, p. 52). This air defense envelope attempts to provide coverage from very low to high altitude against targets at all speeds.<11> The objective of the air defense umbrella is to prevent enemy air action from interfering with maneuver force operations. This is accomplished by destroying enemy air assets that are attacking or by causing them to expend their ordnance at a less than effective range.<12>

Weapons assigned to front air defense are the SA-2 SAM system and possibly a brigade of SA-4 SAMs. SA-3 SAM units are not normally subordinate to the front but may be integrated into its air defense. The combination of these units compose the low to high altitude system that is responsible for the protection of fixed ground based objectives through the depth of Soviet airspace.<13> Both the SA-2 and SA-3 SAM systems have radar target tracking and missile guidance capabilities. However, the SA-2 is unlikely to be effective against a target employing electronic counter measures (ECM) and has a limited capability against low altitude targets. Both the SA-2 and

SA-3 have restricted mobility and displacement time is considerable.<14> It is unlikely that the SA-2 or SA-3 would present a significant threat to the F-16 LANTIRN flying at very low altitude and would be a consideration only if the mission took it deep in the rear area.

Each Soviet combined arms army or tank army is normally assigned a brigade of SA-4 SAMs. Their mission is to augment the division level air defense capabilities in the forward area and to engage and destroy air assets that get past. With an engagement range of approximately 80 kilometers, the SA-4 is primary for providing medium to high altitude air defense. Each SA-4 brigade has 27 transporter-erector-launchers (TELs) which mount 2 missiles each. The PAT HAND fire control radar provides target tracking and missile guidance and also surveillance for target acquisition. The brigade also has the THIN SKIN height finding and the LONG TRACK target acquisition radars.<15>

SA-4 SAM batteries may be found approximately 10 KM behind the army forward forces and then in 25 KM belts behind the front lines. The replacement for the SA-4 appears to be the SA-12 with a 100 KM range and a minimum engagement altitude of 90 meters. The SA-4 is vulnerable to suppressive fires and ECM and its capabilities are significantly reduced when the system is on the move.<16>

Each Soviet division, whether it be a motorized rifle division (MRD) or a tank division (TD), has an organic air defense regiment. Each division air defense regiment will normally be equipped with SA-6 or SA-8 SAM systems. They will also be equipped with the FLAT FACE or LONG TRACK acquisition radars. Each SA-6 or SA-8 air defense regiment has 5 firing batteries and a total of 20 TELs. The SA-8 and SA-6 both have organic radar target tracking and also an optical target tracking capability.<17>

Radar target tracking fire control systems can track airborne targets within their range and altitude capabilities that are flying at night or in the weather. Electronic counter measures (ECM) may degrade radar tracking systems and flying at very low altitude may create additional limitations due to radar ground clutter interference. Optical tracking systems can improve that capability at lower altitudes and shorter ranges. However, to optically track a target the operator must visually acquire and maintain visual contact with the target in order to continue tracking it. Obscuration such as smoke, fog, clouds, flying at night or breaking line of sight by flying behind a mountain or at very low altitude can severely limit or negate the optical track capability.

SA-6 and SA-8 SAMs are employed for low altitude air defense. The SA-6 can engage targets as low as 100 meters

at optimum ranges and a range capability from 4 to 30 KM. SA-8s have an effective range of about 12 KM and will probably be assigned the role of air defense support of first echelon maneuver units due to its shorter range capability.<18> SA-6 and SA-8 SAM systems are both susceptible to suppressive fires and ECM and the exposed radar and wheels of the SA-8 are especially vulnerable to artillery fire. The SA-6 SAM system is normally slaved to the LONG TRACK acquisition radar and is somewhat "blind" without it. It appears the SA-11 is destined to replace the SA-6. It has a longer range and lower minimum engagement altitude capability and has its own surveillance radar for a greater degree of independent operations.<19>

Each Soviet tank regiment (TR) and motorized rifle regiment (MRR) have an air defense battery equipped with 4 ZSU-23-4 anti-aircraft guns and 4 SA-9 SAM launchers. The ZSU-23-4 is a self propelled, 4 barrel, automatic, anti-aircraft gun. It operates with an all weather on board fire control radar and also has an optical target tracking capability. Its maximum range is approximately 2500 meters. The SA-9 is a short range low altitude SAM with 2 to 4 missiles mounted on an amphibious vehicle. Its missile has a passive infrared seeker warhead and has a range of about 6 KM. The system does not have an organic radar, but relies on preliminary target information from the division early

warning radio net.<20>

The ZSU-23-4 has no amphibious capability and is protected with light armor. A high frequency radar emits a very narrow beam which provides good target tracking but limited range. It is normally linked to other long range radars for target acquisition. The unprotected tread and road wheels and especially the radar tracking dish of the ZSU-23-4 are vulnerable to artillery fire and the system is vulnerable to ECM. The onboard fire control radar is subject to ground clutter interference when employed against targets flying below 200 meters.<21>

SA-9 SAMs are employed in conjunction with the ZSU-23-4 in the regimental air defense battery to cover the dead space that is not reached by the SA-6 or SA-8 in the division air defense umbrella. The SA-9 operator is alerted of approaching targets by surveillance data link then tracks the target optically. With no on-board radar, the SA-9 system must rely on crew visual target acquisition. Susceptible to suppressive fires, the SA-9 has a significantly reduced range capability against high speed aircraft. The SA-9 is being replaced by the SA-13 which has a surveillance and ranging radar.<22>

Motorized rifle company air defense is provided by a section of three SA-7 teams. Tank companies do not employ

such a section because of their organic automatic gun capability. The SA-7 is a man portable, shoulder-fired, low-altitude SAM similar to the US Army Redeye. It uses passive infrared (IR) homing guidance and has a range of approximately 5 KM. A target is engaged by visually acquiring and pointing the tube at the target to lock the IR seeker prior to firing. A newer man portable SAM, called the SA-14, is now entering service as a replacement for the SA-7.<23>

SOVIET IADS EMPLOYMENT

Front through division air defense assets are employed to create an area defense within its area of responsibility. The priorities for air defense coverage are (1) troop concentrations, on the march, in attack formations or in assembly areas, (2) command and control facilities, and (3) rear area objectives such as airfields, bases, depots, communication facilities, and support centers.<24> Each asset is employed in a manner which helps achieve the best overall area air defense umbrella.

Because of their limited mobility, the SA-2 and SA-3 units are usually deployed to provide fixed site and area defense for rear area installations. The SA-4 is employed at army level to augment the coverage of forward combat units and to aid in providing coverage of key facilities in

the army rear area. SA-4 units are generally positioned rearward from the FLOT by 1/2 to 1/3 of their engagement range. Their engagement envelope extends from about 45 KM beyond the FLOT (for forward deployed armies) to the army's rear area.<25> These combined assets provide the majority of the protection from high altitude and rear area air threats.

SA-6 and SA-8 units are employed for area defense of the regiment. These units are normally located several kilometers behind the FLOT to avoid exposure to enemy ground based weapons. However, their range still allows engagement of targets well forward of the FLOT. The range of the SA-8 is significantly less than the SA-6, however its high speed mobility and amphibious capability make it well suited for employment with units conducting exploitation and pursuit operations. ZSU-23-4 fire units are normally employed to provide protection of the regiment's lead battalions or first echelon. SA-9s are normally employed as a group, most likely deployed between the first and second echelons of the regiment in an attempt to provide coverage of both echelons and to remain out of the range of enemy direct fire weapons. SA-7s are usually employed as a section protecting each company of the MRR.<26> These assets assigned to army level and below provide the mobile air defense coverage for the armies' maneuver units. See Figure 3-1.

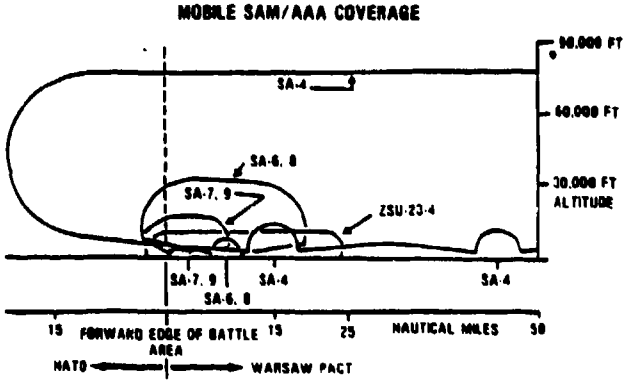

Figure 3-1 <27>

Most target acquisition radars are concentrated in organizations above division level. There, target information is collected and processed by army and front air defense operations centers and passed down to the division. This allows a high level commander to select the weapon system best suited to engage a target.<28> However, this system can lead to less than optimum autonomous operations.

SOVIET IADS VERSUS LANTIRN OPERATIONS

F-16 LANTIRN employment in the night CAS mission could face any of the combined assets of a combined arms or tank army. In a mission of considerable depth, it could also possibly face the air defense assets of a second echelon army. See Figure 3-2. For this discussion, the

combined air defense assets of a typical combined arms army (CAA) and the threat that the CAA poses to night employment of the F-16 LANTIRN will be studied.

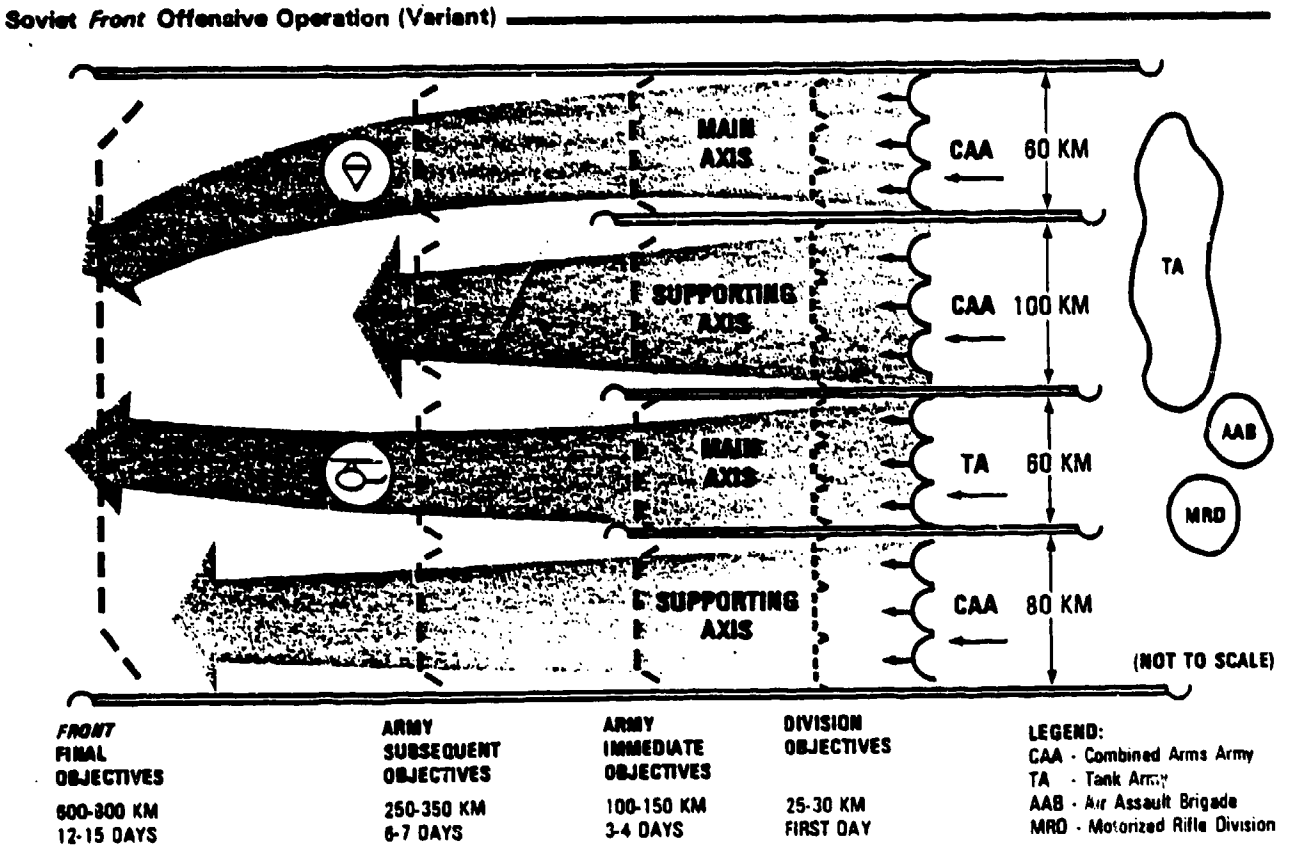

Figure 3-2 <29>

A combined arms army in the first echelon may have two to four motorized rifle divisions and one or two tank divisions.<30> For this study, a CAA of four MRDs and one TD will be addressed. The Soviet concept for the employment of a CAA for offensive operations is shown in Figure 3-3. It shows the Soviet concept of echeloned forces in depth. The objective is for the leading elements to create a

breakthrough and then the follow-on forces to exploit the penetration of defenses.<31>

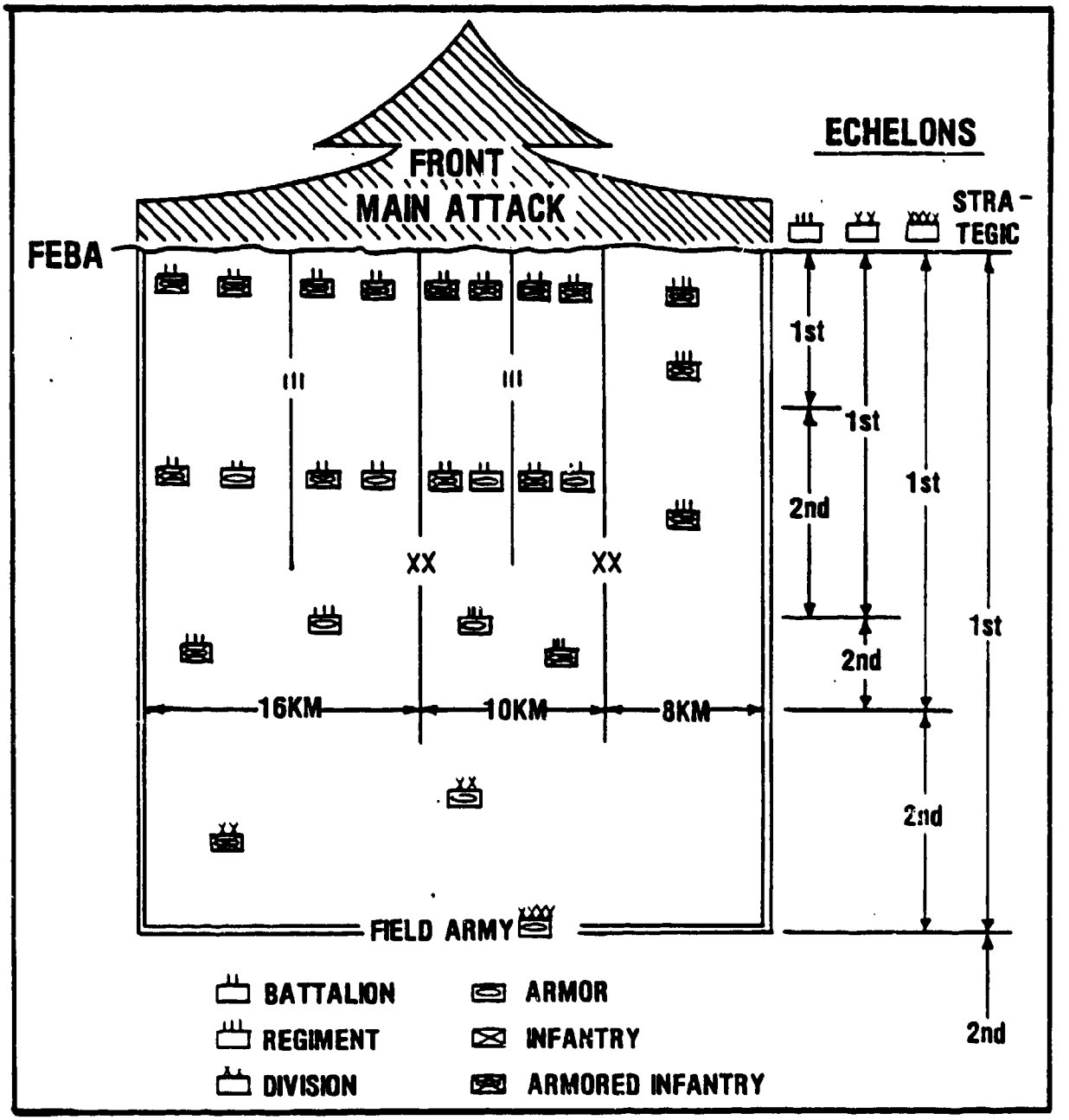

Figure 3-3. <32>

The number of combined air defense weapons in support of the CAA is staggering. 9 SA-4 batteries of 3 transporter erector launchers (TELs) each give the CAA 27 SA-4 or SA-12 TELS employed against long range and medium to high altitude targets. Each division within the CAA would employ a SAM regiment of 20 mobile SA-8, SA-6 or upgraded SA-11 SAM systems. This gives the CAA in this example a total of 100 SAM systems dedicated to defense against low altitude targets using radar tracking and guidance fire control systems. The 4 SA-9 or SA-13 SAM systems and the 4 ZSU-23-4s in each regiment would give the CAA a combined total of 80 each of the passive infrared seeker SAM and anti-aircraft artillery systems. The total shoulder fired SA-7 or SA-14s employed in this CAA area of responsibility is 438.<33> The total is indeed formidable.

With the majority of these assets deployed forward with the lead elements of each division and regiment, it is not hard to understand why the employment of the F-16 in the day close air support role is not highly recommended.<34> It also follows that low altitude high speed penetration of the first echelon air defenses and employment in missions deeper in the enemy rear would be more feasible. However, the night environment changes this picture when the limitations created by darkness are applied to Soviet air defenses.

Soviet integrated air defense system capabilities, although staggering in daylight, are not as formidable when considering each asset during night employment. The major factor that changes these capabilities is the limited ability to visually acquire or track a high speed low flying target at night. Even in bright moonlight, which is rare with the cloud cover in Central Europe, visually acquiring and then maintaining visual contact with a high speed fighter flying at very low altitude would be extremely difficult if not impossible. And being able to accomplish acquisition and track at night while the fighter is still in the air defense system's weapons envelope is even more unlikely. These visual acquisition and optical tracking limitations degrade the capability of some air defense systems and completely remove any capability for others. A close examination of each system employed against the F-16 LANTIRN at night will confirm this.

The SA-4 or replacement SA-12 would not be a considerable threat to night low altitude operation. These SAM systems are designed to attack the medium to high altitude air threat over long distances. The F-16 LANTIRN flying at a very low altitude in the CAS role, although operating within the range envelope, could remain below the optimum engagement altitude of these systems. However, exposure time out of the very low altitude environment would

have to be kept to a minimum to avoid this threat.<35>

Although the passive infrared seekers of SA-7, SA-9 and their replacement systems can effectively track a fighter size target at night, the reliance on crew visual acquisition and optical tracking to direct the seeker severely limits or even totally negates the capability of these systems at night.<36> By operating in darkness, at high speed and at very low altitude, a target would essentially remove the opportunity for acquisition and subsequent tracking within the range and line-of-sight of these systems. However, it would be imperative that operations avoid any means of illumination that might draw attention to the F-16 LANTIRN and aid in the visual acquisition and subsequent IR seeker lock-on. By reducing exposure and avoiding illuminated areas, the F-16 LANTIRN could effectively negate the employment of these passive IR systems.

A system that poses a threat to F-16 LANTIRN is the ZSU-23-4. This system has a good radar tracking fire control capability, however, the radar is subject to ground clutter interference when attempting to track targets flying below 600 feet.<37> Flying at night would also degraded the system due to its inability to effectively employ the optical tracking system as a back-up to radar tracking. High speed F-16 LANTIRN operations at very low altitude at

night would reduced the radar tracking capability, negate an effective optical tracking back-up, and limit exposure time within the range of the ZSU-23-4.

Once the limitations of the previous systems are considered, the main threat to F-16 LANTIRN operations at night and very low altitude is from the SA-8, SA-6, or its replacement the SA-11. Although these SAMs would have an extremely limited if any optical tracking capability at night, their radar tracking capabilities are impressive. Employment of SA-6, SA-8, or SA-11 systems in each division's SAM regiment is not as heavily weighted to the forward elements within the division as those previously discussed. Their employment is primarily for the area defense of each division within the CAA.<38> Providing area coverage for the Soviet divisions, the threat posed by these systems would not vary significantly between F-16 LANTIRN night CAS or BAI missions.

A factor that could have significant effect on the success of F-16 LANTIRN night operations is the support provided by assets conducting suppression of enemy air defenses (SEAD). Air assets, such as the EF-111A and F-4G Wild Weasel, conduct SEAD operations day or night and direct their efforts toward radar acquisition and radar fire control systems.<39> Since the greatest threat to F-16 LANTIRN night operations is by these radar capable systems,

SEAD operations have an even greater capability to ensure to mission success.

The threat to F-16 LANTIRN operations at night is real, but, it is not as staggering as the threat that can be presented during the day. Employment of those systems that have a reasonable capability at night presents a threat that is fairly equal throughout the CAA area of operations. Any mission flown by the F-16 LANTIRN at night, whether it's CAS or BAI, would face essentially the same level of threat and that threat would be considerably less than the one presented in daylight.

SUMMARY

The window of opportunity for operations by the F-16 LANTIRN in the night CAS mission is significant. It gives a three fold increase in offensive air support capabilities in winter months and even a significant increase in summer. Maintaining an effective low-level air attack capability through all seasons in Central Europe is directly addressed by the F-16 LANTIRN system.

Historical weather trends in Central Europe show that low cloud bases and visibilities are the norm more often not. This appears even more during the winter months when the hours of darkness are long. The capability to fly at very low altitude at night becomes significantly more

important for 24 hour operations with typical Central European weather. That capability again opens a window to conduct operations that is not currently available.

The Soviet integrated air defense system employed in Central Europe is indeed formidable. The number and capabilities of the air defense weapons that make up that system are a significant threat to any air operations over Soviet ground forces. However by reducing or removing the effectiveness of many of the air defense weapons by flying high speed at night at very low altitude, the F-16 LANTIRN could very well find itself in a less threatening environment. With the combined efforts of air and ground based SEAD operations, the F-16 LANTIRN may have a significant capability to conduct night CAS operations in spite of the Soviet integrated air defense system.

CHAPTER 3

ENDNOTES

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31. TACM 2-1, p. 2-6.

32. Ibid.

33. FM 100-2-3, pp. 4-34, 4-106 and 4-118.

34. DIA, Soviet Front Fire Support, pp. 53 to 55.

35. FM 100-2-3, p. 5-99.

36. Ibid., pp. 5-92 and 5-93, and DIA Soviet Front Fire Support, p. 47.

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CHAPTER 4

F-16 LANTIRN GROUND ATTACK

In this chapter the conventional weapons attack capabilities of the F-16 LANTIRN will be discussed. Aspects of a fundamental ground attack profile will be examined and then the LANTIRN system capabilities will be reviewed to see how the system meets basic attack profile requirements. Once a clear picture of the basic attack capabilities is presented, then assessment of the F-16 LANTIRN to meet the specific and unique requirements of the night CAS mission (Chapter 5) can be made.

The basic ground attack profile can be broken down into several segments required for mission accomplishment. For the purpose of this study three areas that are fundamental to an air-to-ground mission will be considered. These are mission planning, low level flight and navigation, and target attack. A careful examination of the F-16 LANTIRN in these phases will present a good description of its basic ground attack capabilities and limitations.

THE LANTIRN SYSTEM

In today's high threat environment, the capability to fly very low, day or night, under adverse conditions and acquire tactical ground targets with minimal exposure to

enemy ground fire is significant. To reduce exposure to the air defense threat, the mission time line must be short. The pilot must be able to acquire the target and deliver weapons on the first pass at high speed.

For a weapon system to be successful in this environment, it must be able to deliver a wide variety of weapon types and to navigate with precision and at very low altitude. To be successful in a European type weather environment, it is important to have the capability to letdown through clouds and permit safe terrain-following flight through weather that occasionally obscures terrain from the pilot's view.<1> The LANTIRN system attempts to accomplish these requirements by combining forward-looking infrared radar (FLIR) and radar technology for both navigation and target attack functions.

For navigation, the LANTIRN system provides a wide field-of-view FLIR "night window" and terrain-following radar inputs for safe flight at extremely low altitude at night.<2> The system's navigation pod consists of both a wide field-of-view FLIR sensor and a terrain-following radar. The heads up display (HUD) used in the system is state of the art and presents an instantaneous 21 degrees vertical by 28 degrees horizontal field-of-view wide enough for viewing the entire navigation pod FLIR video. The HUD still retains all the capabilities for non-LANTIRN flight

and weapons employment operations that are found on the standard F-16 HUD.<3> See Figure 4-1.

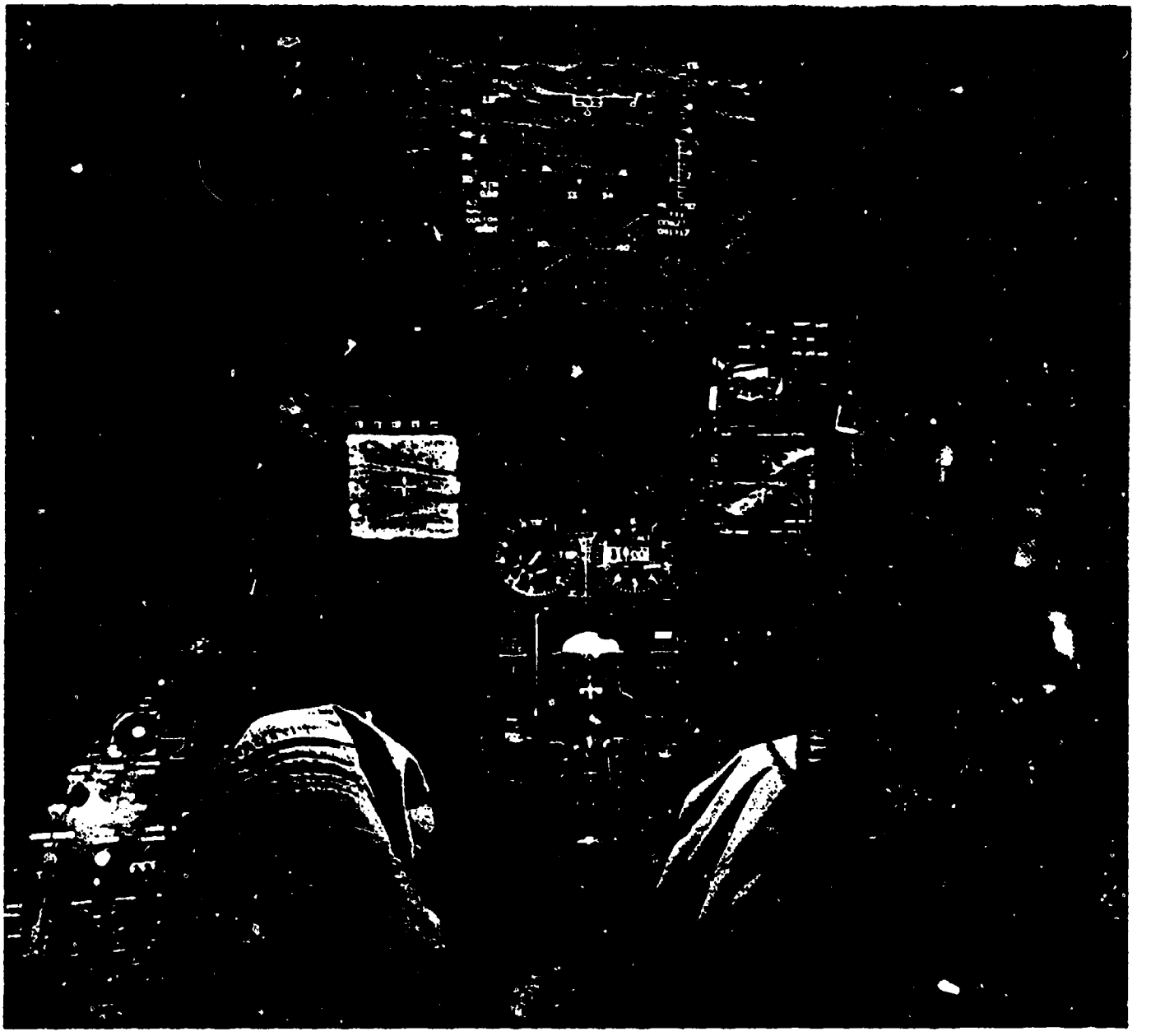

Figure 4-1.<4>

Pilots view of the night cockpit and FLIR video presented on the HUD.

The picture presented on the HUD, described by Col. James A. Fain, director, strike systems program office, Aeronautical Systems Division, (ASD), "gives the pilot a 'night window' showing him scenes outside of his aircraft as if they were actually visible to him in the adequate light of early evening, with twilight just beginning to gather."<5>

For the target attack function, the system incorporates the navigation pod and a targeting pod which enhances weapons delivery. Target acquisition, weapon hand-off and target designation can be accomplished through the targeting pod.<6> The targeting pod contains a stabilization system and a FLIR system with magnified wide and narrow field-of-view options. The F-16C presents the targeting pod magnified video on one of two television screens called multi-function displays (MFDs).<7> There, the pilot can monitor the magnified narrow or wide field-of-view FLIR picture for more accurate target information. Figure 4-1 also shows the position of the two MFDs.

The targeting pod is also coupled with automatic target trackers and a laser designator. This gives the system a greater range standoff capability and increased precision for weapons delivery.<8> Closer examination and further description of these LANTIRN subsystems will be discussed during the study of each segment of the ground

attack profile.

MISSION PLANNING

Ground attack mission planning is conducted by tactical aircrews to map out the plan for attack against the target or array of targets. It includes but is not limited to route selection to the area of operations, analysis of the threat, calculation of weapons delivery parameters and delivery profiles, and command and control coordination.

Mission planning for F-16 LANTIRN pilots in preparation for a night ground attack mission would be much the same as for any other tactical aircrew, with the exception of some special planning considerations. For route selection and attack planning, the pilot must consider turn points or reference points that are easily identified by IR signature and that are within the 28 degree HUD field-of-view. Intelligence predictions of turn points detection range in the IR spectrum could aid in this planning. Greater accuracy in target and turn point coordinates is required to compensate for a reduced field-of-view.<9> To optimize use of the targeting pod's magnified FLIR capability, target coordinates should be precise to orient the pod's "telescope" field-of-view to the preplanned target area. Determination of threat capability and location is also vital to mission success and emphasis should be placed

on locating and avoiding, as much as possible, threats that have a good low altitude, night-engagement capability.

Due to the difficulty in referencing maps in the cockpit at night, premission planning that includes thorough route and target area study and preparation of route and target area charts with readily identifiable markings becomes critically important.<10> Again special consideration should be given to intelligence predictions of detection range in the IR spectrum (IR signature) for selecting easily identifiable features.

Planning must consider a mission profile that is consistent with use of the navigation pod for navigation and low-level flight. According to Tactical Air Command's LANTIRN concept of operations, this would include flight integrity defined as coordinated single ship. Flights would plan, brief, conduct ground operations and launch as a flight. However ingress and attack would be conducted single ship. Appropriate deconfliction between aircraft during the ingress and attack must be planned and assistance available through radio communication with flight members coordinated.<11>

LOW-LEVEL FLIGHT AND NAVIGATION

The night low-level flight and navigation problem is solved in the LANTIRN system with the use of redundant

sensors, a FLIR complimented by a terrain-following radar (TFR) in the navigation pod. The system displays both the FLIR imagery and terrain-following "fly-to" cues on the HUD. The pilot can use the combined data synergistically while keeping his attention outside the aircraft.<12> Navigation is accomplished by FLIR video pilotage and dead reckoning assisted by the F-16 inertial navigation system (INS), radar, and global positioning system (GPS).<13>

Flight test evaluation of the LANTIRN system low-level flight and navigation capability was conducted under the terms of a joint agreement between the US and Canada in 1985. Flight tests took place in areas of Canada where weather was of a European-type climate.<14> The test objective was twofold. First, it was to evaluate the subsystem performance of the navigation pod and HUD. Secondly, it was to evaluate the overall system capability to accomplish single-seat, night, low-altitude manual terrain following while navigating to and from a target area.<15>

Test flights were categorized as "tough ones" where test pilots and tactical air force pilots flew more than 480 night flight hours, covering an estimated 15,000 miles at altitudes of 500 feet and below.<16> The following excerpts are from the report of those test results:

"The navigation pod FLIR sensor produced an image of the terrain which provided the pilot a very good cross-check of the terrain-following radar (TFR) commands to allow night low altitude flight in an operational environment. The video quality allowed low altitude navigation in conjunction with the TFR at altitudes down to 100 feet over unfamiliar terrain. Large turn points or targets such as power plants, production facilities, islands and airfields could be typically detected 10 to 15 miles from an altitude of 200 feet (providing there was a clear line-of-sight to the object). Smaller objects such as rail roads, river inlets, bridges, and road intersections were not always detected. INS accuracy had a significant effect on the pilots ability to detect the target or turn point. The terrain-following radar (TFR) provided very good overall performance over all types of terrain tested. The manual system was easy to fly at all clearances including 200 feet over mountainous terrain."<17>

"Overall, the LANTIRN navigation pod provided the single-seat F-16 pilot with the capability to fly and navigate at night at altitudes down to 100 feet under the weather, to and from the target area. Night low-level navigation while performing manual terrain following was accomplished with an acceptable pilot workload."<18>

The initial operational test and evaluation of the F-16 LANTIRN system followed the 1985 flight test evaluations and was successfully completed in April 1986. Once again the ability of the pilot to successfully use the navigation pod FLIR imagery together with the TFR manual flight commands was conclusively established.<19>

F-16 LANTIRN ATTACK

The LANTIRN system was designed to provide an attack capability using conventional weapons and daytime delivery

techniques at night.<20> The flight test evaluation conducted in 1985 reported that the navigation pod FLIR image enabled the F-16 pilot to overfly and bomb targets in the dark, at low altitude safely.<21> However, the first task that must be accomplished for a successful ground attack is target acquisition.

According to flight test and evaluation pilots "if the target was big enough that it could be seen in the daytime, it could be seen and hit at night with the use of the navigation pod. But, the target would have to be large and an area type weapon would be best, not surgical removal of high value targets."<22> However, the navigation pod FLIR sensor video was successful in detecting armored vehicle size targets when the exact coordinates were known and the inertial navigation system (INS) accuracy was good.<23> Another capability of the navigation pod video was the ability to distinguish targets from the background. In most cases, the FLIR video extended the range of target acquisition at night farther than the naked eye in daylight. See Figure 4-2.

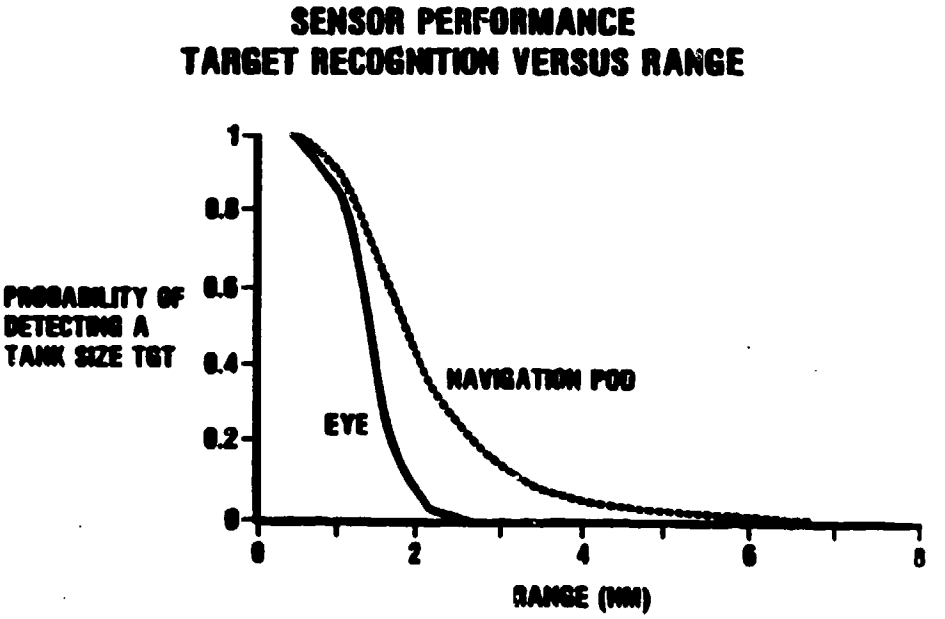

Figure 4-2. <24>

The targeting pod is designed to be effective at night against targets as small as tanks. The idea was that if the system could pick out a tank, it would have no trouble picking out larger higher priority targets like SAM sites, bridges, command centers, dams, etc.<25> By selecting the targeting pod FLIR magnified wide field-of-view, the system permits initial acquisition of targets that fall within this wider field and range. Normally effective against preplanned targets, the targeting pod aids initial acquisition by using the INS to direct the FLIR sensor to look at the region expected to contain the targets and alert the pilot via cues on his HUD. Once acquired, the narrow

field-of-view can present even greater target magnification for better discrimination and system refinement.<26>

Due to the limited "telescope like" field-of-view of both the wide and narrow FLIR magnification options, directing the targeting pod sensor can be critical to effective targeting pod employment. The targeting pod sensor can be accurately directed using precise target coordinates with an accurate INS system, by radar inputs, or with updates from the pilot after initial target acquisition. Targeting pod FLIR video is presented to the pilot on one of the two cockpit multi-function displays (MFDs). Figure 4-3 shows representative FLIR video MFD presentations.

Figure 4-3. <27>

Targeting pod narrow field-of-view FLIR video presented on an MFD.

Before continuing with the attack profiles available to the pilot after target acquisition, a discussion of the guided and unguided weapons available for delivery from the F-16 LANTIRN is required.

WEAPONS AVAILABLE

The F-16 LANTIRN can deliver a wide variety of general or specific use weapons. These can be categorized as guided or unguided munitions. Unguided munitions are those that once released from the aircraft freefall to the impact point. The aircraft release parameters determine where the unguided munition will impact. Guided munitions have some means of terminal guidance and a flight package that once released from the aircraft directs the munition to the impact point. A discussion of the various guided and unguided munitions available to the F-16 LANTIRN follows.

The F-16 employs a 20 mm cannon carried internally. 20 mm ammunition can be used against trucks, light armored vehicles, personnel and equipment. However the effectiveness of the 20 mm in the ground attack role is extremely limited and is not generally recommended for air-to-ground employment.<28>

The first type of unguided freefall weapons that the F-16 carries are general purpose (GP) bombs. These bombs are designed for blast and fragmentation effects against

buildings, bunkers, bridges, vehicles, personnel and equipment. They are not a very good munition against armored vehicles and would require almost a direct hit for a kill. The standard GP bombs carried on the F-16 are the 500-pound MK-82 and the 2000-pound MK-84. They can be dropped in "strings" or "sticks" of two to six bombs to cover a target. High drag fins or parachute assemblies can be attached to the bomb bodies to allow very low altitude delivery.<29>

Another type of unguided munition is the cluster bomb unit (CBU). CBUs consist of hard-shell dispensers filled with a variety of bomblets. The dispensers are dropped like bombs, and at a predetermined time or height above the ground, they split open and scatter their bomblets. Bomblets are designed for antipersonnel, antiarmor, or antimaterial effects and can also have delayed time fuses. An example of CBU type munition is the MK-20 Rockeye. It contains 247 shaped charged bomblets, each bomblet weighing 1 1/2 pounds, which will penetrate 7 1/2 inches of armor.<30> Another recently employed CBU is the CBU-87, which is a combination shaped-charged bomblet for antiarmor with fragmentary and incendiary effects for antipersonnel and antimaterial. The F-16 can also carry the CBU-89 Gatormine, which is an airdroppable CBU version of the family of scatterable mines (FASCAM).<31>

A guided munition that is available for employment on the F-16 is the AGM-65 Maverick antitank missile. It has a shaped-charge to penetrate armor and is effective against targets with all types of armor protection. Versions include a television (TV) or imagery infrared (IIR) seeker contained in the missile to home on the target after launch. Once launched the missile guides itself and the pilot is free to egress or reposition for a subsequent attack. The IIR version which will be carried on the F-16 LANTIRN uses a thermal-imaging seeker and can detect targets either hotter or cooler than the associated background. The seeker is unaffected by smoke, haze, or darkness and can detect even camouflaged operating vehicles. In some cases the pilot may see the target through the missile seeker before seeing them visually.<32>

Another guided munition in the F-16 LANTIRN weapons inventory is the laser guided bomb (LGB). The LGB is a general purpose bomb (such as a MK-84) that utilizes an attached seeker package to detect laser energy reflected from a laser marked/designated target and through signal processing, provides guidance commands to a control system that guides the weapon to the point from which the energy is being reflected. LGBs can engage a wide range of targets. Because of their terminal accuracy, LGBs require fewer munitions to ensure the desired effects on targets. LGBs

are excellent weapons against high priority fixed targets.<33>

WEAPON DELIVERY PROFILES

Unguided conventional weapons can be delivered from the F-16 LANTIRN in three basic attack profiles, level, loft and low angle dive delivery. Due to the 28 degree wide field-of-view presentation of the navigation pod FLIR, the attack profile requires a direct approach to the target. For a level or loft delivery , the pilot flies a bump-up attack. At about 5 miles from the target area he climbs slightly to get line of sight with the target. He then continues low level to the target for a level delivery or initiates a climb to toss the weapons at a standoff distance for a loft delivery (See Figure 4-4). For a low angle dive delivery, the pilot does a straight ahead fly up for altitude to accomplish the direct attack and to aid in target acquisition. He then continues the low angle dive to weapon release (See Figure 4-5).<34>

BUMP-UP ATTACK

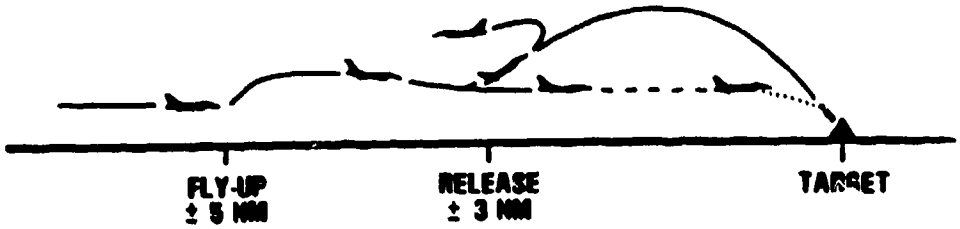

Figure 4-4. <35>

DIRECT ATTACK

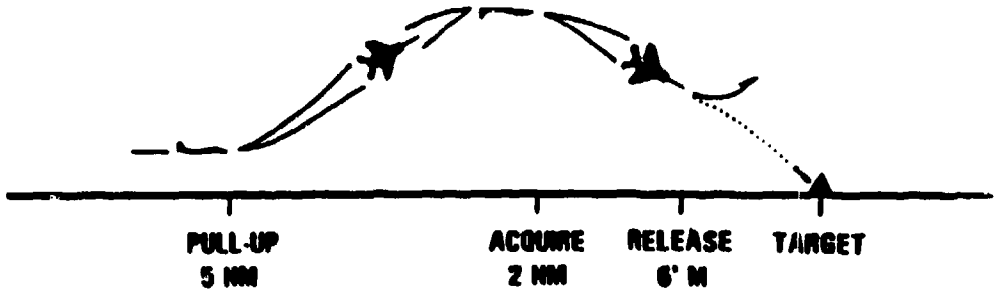

Figure 4-5. <36>

In these basic night-attack scenarios both the navigation and targeting pod can be used. The navigation pod gives the pilot the capability for a night visual low-level ingress and attack. Weapons delivery using the existing F-16 systems is available with the same symbology presented on the HUD that is used for daytime attacks. The targeting pod is integrated with the aircraft's inertial navigation system (INS), providing an additional means to acquire targets as long as target coordinates are accurately known. The pilot detects the target using the pod's magnified wide field-of-view FLIR imagery displayed on one of the two MFDs, then switches to the narrow field-of-view FLIR for up to nine times image magnification. He can then engage the target tracker which locks the targeting pod FLIR sensor on to the target and automatically tracks it.<37>

For conventional bomb delivery, the targeting pod laser can be fired to improve accuracy of range data which is fed to the aircraft's fire control computer.<38> This highly accurate target angle, angular rate and range information is provided for conventional fire control solutions and enables much improved accuracy in delivering unguided ordnance. The updated information used by the fire control computer can improve accuracy in both standoff loft deliveries and direct approach level or low angle diving delivery profiles.<39>

Guided munitions can also be delivered effectively by the F-16 LANTIRN weapon system. The LANTIRN system gives the F-16 the capability to deliver LGBs and Maverick missiles at night from a low altitude ingress and attack profile. The navigation pod provides the same low-level target ingress capability as it did for the conventional weapons delivery profiles. The targeting pod has additional capabilities that allow effective guided munition employment. The wide field-of-view magnified FLIR video is again used to attempt initial target detection. Subsequent selection of the narrow field-of-view FLIR allows target selection and automatic target tracking lock-on.<40>

For attack with the IIR Maverick a bump-up attack profile is flown.<41> A direct approach to the target area is made, the pilot flies up just enough to allow line of sight with the target area. Target acquisition can be aided by INS steering and HUD or targeting pod FLIR video. After automatic target tracking lock-on, selection of the Maverick missile activates a missile boresight correlator which slews the missile seeker head to the target for missile lock-on. Once the pilot confirms the missile lock-on the missile is fired and the system resets to engage another target.<42>

Pilots that flew the system during the follow-on operational test and evaluation program stated that the targeting pod significantly enhanced the F-16 IIR Maverick

employment because of improved target acquisition range and a multiple launch capability against preplanned targets.<43> The combination of the targeting pod earlier target discrimination and the missile boresight correlator function gave the F-16 LANTIRN system a two Maverick launch per pass capability.<44>

To deliver an LGB, the pilot uses a direct approach to a loft delivery. Target acquisition is accomplished in a bump up attack as discussed before. Once automatic target tracking is achieved the laser designator is activated, the LGB is then released in a loft profile, and the laser continues to illuminate the target until weapon impact.<45> The pilot must fly in the vicinity of the target to allow the system to keep line-of-sight for continued automatic target tracking and laser illumination until weapon impact.

LGB delivery and the self designation capability of the F-16 LANTIRN was tested during the follow-on operational test and evaluation program for the targeting pod in 1987. The report stated that the the targeting pod conferred a limited day and night LGB self designation capability. However, the delivery procedure was workload intensive and the report recommended that LGB employment be limited to highly qualified pilots only. It also stated that due to the complexity of the operation, only prominent targets be selected for LGB attack.<46>

SUMMARY

The LANTIRN system gives the F-16 pilot a previously unavailable night, low altitude attack capability. The navigation pod's terrain-following radar (TFR) and wide field-of-view FLIR sensor enable the pilot to fly at night and under the weather at very low altitudes. The targeting pod provides an added sensor for improved conventional weapon delivery, a significantly enhanced IIR Maverick capability and a limited LGB capability against preplanned targets.<47>

Although the LANTIRN system gives the F-16 pilot a good basic night attack capability, it has definite limitations that must be considered. Mission planning is critical and target and turn point IR signature detection range must be predicted and taken into account. Attack profiles are limited to a direct approach and initial target acquisition through the HUD is limited to those targets that fall within the 28 degree wide field-of-view. Target coordinates must be timely and precise and the navigation system must be accurate to ensure the target can be acquired inside the navigation or targeting pod's FLIR field-of-view. Depending on the timeliness of target information, this could severely limit attack against unplanned or mobile targets which are characteristic of CAS.

Employment of the F-16 LANTIRN in the ground attack role gives the tactical air forces a fundamental low-level night attack capability that was previously unavailable to the tactical community. However, consideration must be given to the specific system capabilities and limitations and level of pilot workload required for success prior to assigning it to a night CAS mission which has unique requirements.

CHAPTER 4

END NOTES

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CHAPTER 5

F-16 LANTIRN AND NIGHT CAS

Now that a review of the F-16 LANTIRN capability to perform fundamental night ground attack has been completed, a look at the ability of this system to meet the specific needs of the night CAS mission can be accomplished. This chapter will address the elements that are unique to CAS mission success. The study of those unique elements and the ability of the F-16 LANTIRN to meet the requirements will be the basis for conclusions about mission effectiveness.

As previously defined, close air support is "air action against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces." Planning considerations and control requirements for attack of "hostile targets in close proximity to friendly forces" will be studied in this chapter. Additional elements of CAS that will be studied are target marking and friendly force identification, requirements that provide "detailed integration of each air mission with the fire and movement of those forces."

CAS PLANNING CONSIDERATIONS

Close air support operations require coordinated

planning by Army and Air Force elements within the ground force unit. The Army selects the targets, and the Air Force coordinates and controls employment of the tactical fighters. The Air Force elements normally consist of a forward air controller (FAC) and/or a tactical air coordinator-airborne (TAC-A) and members of the tactical air control party (TACP).<1>

The TACP at battalion level normally consists of an air liaison officer (ALO) and two enlisted tactical air command and control specialists. The TACP advises the ground forces commander on the employment of TACAIR. It also requests and controls CAS. The FAC is a member of the TACP who, from a forward ground or airborne position, controls aircraft in close support of ground troops. The TAC-A is an officer who usually operates from an airborne position away from enemy air defenses and coordinates the employment of aircraft tasked for air support, but normally does not provide terminal final control. This combined team, together with ground force fire support elements, plan and coordinate CAS operations.<2>

The close air support mission can entail a wide spectrum of operations, however, CAS is most often associated with the classic troops-in-contact (TIC) situation.<3> This type of operation requires special planning considerations in order to be responsive and

flexible to meet the ground commander's needs. For the CAS mission to succeed, planning must consider weather, integration of organic fire support, target acquisition, suppression of enemy air defenses (SEAD), target marking, location and identification of friendly forces, general ordnance characteristics, final attack direction, and aircraft and friendly forces safety.<4>

The amount of premission planning conducted by the pilot is going to be limited due to the dynamics of the CAS mission. Both preplanned and immediate CAS missions can be launched from a scheduled takeoff time or from an alert posture. The F-16 pilot can also be diverted from a previously assigned mission to a ground forces engagement that requires priority air support assistance.<5> The ability of the pilot to conduct premission planning will depend on the type of mission response required and information available for planning.

For a preplanned CAS mission, the air tasking order (ATO) from higher headquarters should provide controlling agency callsigns, mission numbers, radio frequencies, general target location and description if available, and any other pertinent information. However, a CAS mission in response to an immediate request may not provide the pilot with any opportunity to study the information normally contained in the ATO. Pilots on a CAS alert status may be

directed to make a scramble takeoff and to contact a control and reporting center (CRC) who will give flight directions to a contact point. The CRC will also provide the pilot with the forward air controller (FAC) callsign and radio frequency for initial contact.<6> A pilot who has been diverted to CAS from another mission would also be directed to contact the CRC and be given the same limited information.

Chapter 4 described the importance of detailed premission planning and target area study for success in the F-16 LANTIRN ground attack. Any realistic map study and target area familiarization would have to be accomplished by the pilot prior to takeoff. Attempting to study or reference a map in detail while flying at night is virtually impossible. In addition, any assistance for predictions of significant infrared signatures in the target area would be similarly impossible once airborne. These factors suggest the difficulties that would be encountered in an immediate or diverted CAS mission response and even in a preplanned CAS mission unless the exact target location is known prior to takeoff.

The result of these limitations would be a heavy reliance by the F-16 LANTIRN pilot on the proper planning, guidance and control provided by the elements of the TACP. Success of the CAS mission depends on three issues: the

planning conducted, the timeliness and ability to pass vital mission information to the pilot, and the capability to provide effective control in the final phase of attack.

MISSION CONTROL

As previously discussed, the pilot, after takeoff, will normally contact the control and reporting center (CRC) which provides flight monitoring and direction if required to a contact point. The contact point is a position at which the pilot makes radio contact with the tactical air control party.<7> If the pilot was diverted to the CAS mission or is required to hold for the mission, he may be directed to an orbit point for initial contact and mission briefing. Orbit and contact points should be provided in the ATO.<8>

The contact point (CP) would normally be located far enough from the forward edge of the battle area to minimize the threat of enemy air defenses and communications jamming (See Figure 5-1). There the tactical air coordinator-airborne (TAC-A) would brief incoming flights. The TAC-A coordinates CAS operations, the FAC controls them. Located near the CP, the TAC-A is positioned to provide effective communications with fighters, FAC and ground agencies. The TAC-A will normally conduct the in-depth mission briefing with the fighters and then transfer them to the FAC for

final attack control.<9>

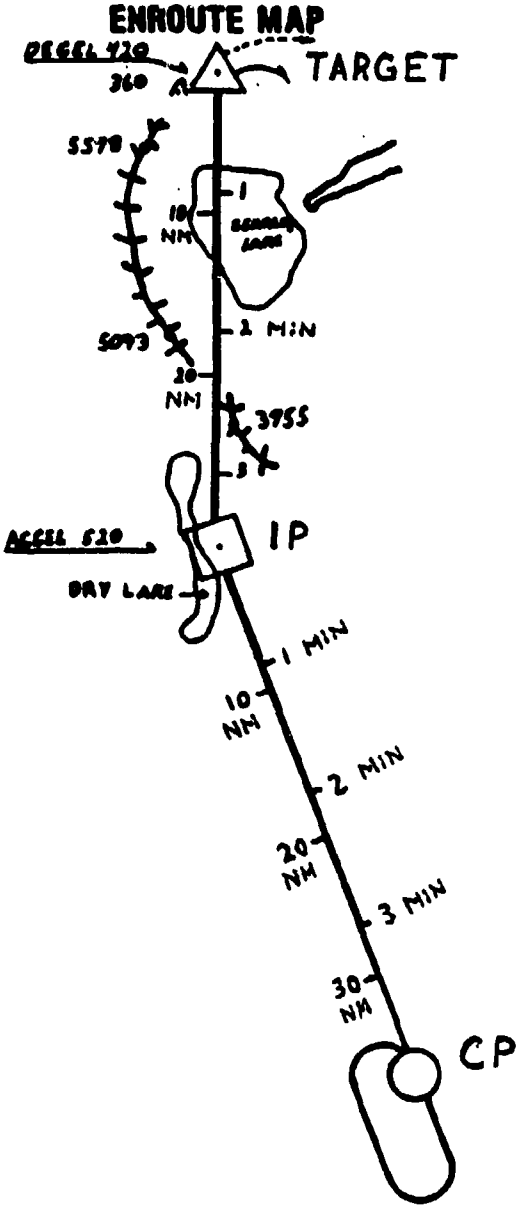

Figure 5-1. <10>

Typical CAS Profile showing contact point (CP), initial point (IP) and target.

Transfer of information to fighter aircraft in the CAS briefing is critical for mission success. The fighters, on initial contact, will provide the TAC-A with callsign, mission number, flight size, ordnance carried and time available for the attack.<11> The TAC-A gives the fighters the CAS briefing, which may be abbreviated in a communications jamming environment. The CAS briefing includes the following: initial point (IP), the point used to start the attack; heading from the IP to the target; distance from the IP to the target; target elevation; target description; target location, given in longitude/latitude or UTM grid coordinates; type of target mark, if used; location of friendlies (precise location must be given for any troops within 1000 meters of the target); egress direction; and other remarks as necessary.<12> See Figure 5-1.

Information and target data given in the CAS briefing is critical. However, receiving and using the information can be difficult and workload intensive for the F-16 LANTIRN pilot. Flying at night requires total concentration using outside and/or cockpit instrument references to ensure a safe flight attitude is maintained. To receive the briefing, the pilot would have to divide his attention between flying and entering the data into the aircraft avionics system. The pilot would be required to fly at a higher altitude, higher than a normal low-level

ingress, in order to accomplish this and would most likely be required to maintain a holding orbit until the briefing is concluded.

Recording the information while flying would be difficult if not impossible and entering the required data into aircraft avionics systems would be time consuming, task intensive, and could lead to inadvertent errors. The Block 40 F-16 LANTIRN is not configured with an automatic target hand-off system (ATHS). ATHS is a data transfer system which uses digital data bursts to facilitate ground-to-air or air-to-air communications.<13> For the F-16 LANTIRN pilot tedious manual data entry would be required.

As examined previously, the capability to conduct premission planning is limited. Therefore, the information passed in the CAS mission briefing is critical. Accuracy and timeliness is all important and any errors could result in an aborted mission or tragedy. The situation that the pilot is in while entering this data is difficult and it could be concluded that the ability to effectively transfer this information is extremely limited and time consuming.

One of the critical elements of the briefing is the target description. The description must be clear and concise and normally uses a reference point method. Using this method, the description starts at a prominent reference

point and concludes with a description of the target itself.<14> For the description to be effective the briefer would have to take into consideration the limited 28 degree field-of-view that the F-16 LANTIRN pilot has through his HUD at night and the relative infrared significance of targets or reference points.

Since targets assigned to CAS missions are not normally preplanned and often are mobile, timely accurate target information is critical to mission success. Add to that the limited field-of-view of the F-16 LANTIRN FLIR video and timely target information becomes even more important. Target data that is five minutes old may be unusable to the F-16 LANTIRN pilot if the targets have moved out of his field-of-view. Also, data that is not precise or an aircraft navigation system that is inaccurate may prohibit target acquisition. The flexibility of the F-16 LANTIRN to effectively acquire and attack targets that are mobile or not preplanned in a close air support profile could be severely limited without additional guidance.

Once the pilot has an understanding of the information passed and the data has been entered, the TAC-A clears the aircraft for the final phase of the attack. If the target is at a far enough distance from friendly forces, such as enemy artillery 5 to 10 kilometers beyond the FLOT, the fighter may be cleared by the TAC-A for the attack and

weapons release without requiring direct final control.<15> In this situation the attack is conducted under flight lead control and from this point on the final attack is similar to any other ground attack mission.

This profile could also be flown by an aircraft tasked for a BAI mission with instructions to contact the TAC-A for target update information. After information transfer, no further control would be required. the TAC-A would only give this clearance to CAS or BAI aircraft when target proximity to friendly forces was such that he could guarantee that there was no threat of attacking friendly troops.

However, in the typical troops-in-contact CAS situation, the fighter is cleared for the attack and directed to contact the forward air controller (FAC). The FAC is responsible for the safety of fighter aircraft and friendly forces and provides coordination and control for the final phase of the attack.<16>

FINAL ATTACK CONTROL

The FAC can provide final attack control from a forward ground or airborne position. He can operate on foot, from ground vehicles, or from fixed or rotary wing aircraft.<17> The FAC's responsibilities include planning the attack to avoid ground fire and friendly troop

positions. He must coordinate the air attack with the fire and movement of friendly forces. He arranges, if necessary, for target marking fire and suppressive fire onto enemy air defenses within his area of operations. The FAC is the final authority for clearing aircraft to expend ordnance.<18>

In planning the attack, the FAC must consider the required minimum safe distance from friendly positions that ordnance can be dropped. Figure 5-2 gives the recommended minimum safe distances in meters for the employment of typical munitions carried on the F-16.

Figure 5-2. <19>

Minimum Safe Distance of Aircraft Delivered Ordnance

Ordnance Type	Minimum Safe Distance (meters)	
	10% PI*	0.1% PI*
Mk 82 LD 500lb bomb	250	425
Mk 82 HD 500lb bomb (retarded)	100	375
Mk 84 LD 2000lb bomb	275	500
Mk 20 Rockeye (anti-armor CBU)	138	280
CBU 52 anti-material	270	450
CBU 58 anti-personnel	325	510
CBU 87 combined effects munition	185	275
AGM 65 Maverick	75	100

*PI - Probability of incapacitation of ground forces.

Further recommendations in the Joint Application of Firepower (J-Fire) Reference Guide, TACP 50-18, are that Mk

20 and CBU munitions not be used near troops-in-contact due to the varying dimensions of coverage of these area munitions.<20>

This minimum safe distance table demonstrates the critical nature of the elements in the execution, coordination and control of an air attack. The pilot must be able to precisely identify the target or target area and be able to distinguish between enemy and friendly troop positions. The FAC is responsible for the final phase of the air attack and must be able to recognize and stop any attack that jeopardizes the safety of friendly troops.<21>

Final control starts after the mission briefing when the pilot is cleared to proceed for the attack and directed to contact the FAC. Minimum radio calls are made to minimize communications jamming. The pilot calls departing the initial point (IP), the point used as a starting position for the run to the target.<22> This call is used to coordinate SEAD or marking procedures. In the typical day CAS mission, the FAC will attempt to pick up the fighters visually and give final directions to help them acquire the target. Once the FAC has the aircraft in sight, he can direct the pilot via radio transmissions giving directive and descriptive commentary until the fighter is lined up on the final attack heading. If the attack aircraft is not aligned with the correct target or it

appears that friendly troops may be in danger, the attack must be aborted by the FAC.<23>

However, in the F-16 LANTIRN night attack, it is highly unlikely the FAC would visually acquire the aircraft to provide final direction and attack clearance. Flying at high speed and low altitude to avoid visual acquisition by enemy air defense threats at night is the basis of F-16 LANTIRN threat avoidance. Even if the target area is illuminated by some means, such as flares, is it unlikely that the FAC will visually acquire the F-16 LANTIRN in time to provide effective final attack direction or to prevent inadvertent weapons release on friendly positions.

It can be reasonably concluded that the FAC would be extremely limited in his ability to visually acquire and provide direction to the pilot in the final phase of the night attack. He would also be unable to call a timely abort if the pilot was unintentionally attacking the wrong target or friendly positions. An alternative to direct control of the final attack by the FAC could be provided by clearly indicating target or friendly troop positions to the attacking pilot by a positive, unmistakable and uncompromised means. Correct pilot identification of a target as enemy or friendly, in addition to acquiring and distinguishing the target from the background, becomes critical in CAS.

TARGET IDENTIFICATION

The first priority for any successful CAS mission is accurate identification of the target. The greatest error in weapons delivery may be caused by misidentifying a friendly target as enemy. The dynamics of a changing battlefield can complicate this task. Late target acquisition, decoys and natural features that resemble targets may all lead to attacking the wrong target by mistake.<24> A precise description of the target in relation to the terrain features easily visible from the air and a positive target mark are critically important. Target identification is always difficult at the range fighter aircraft must line up for attack, so a distinct target mark is a prerequisite for accurate bomb delivery on the correct target, especially at night.<25>

There are many means of target marking available. However, the number that are effective in a night situation is reduced significantly. Marking a target or a suitable reference point is normally accomplished by physical or electronic means. A physical reference can be a natural feature, river bend, distinctly shaped wooded area, or lake. Artificial references such as colored smoke or fluorescent ground panels can also be placed instead of, or as an aid to recognition of the natural feature.<26> But, artificial references that are effective for day operations are often

inappropriate at night and relying on natural features alone can be less than optimum, especially in an area where distinct features are not present.

Other techniques used at night include illuminating the target area with flares released from FAC or flare aircraft or fired from artillery or mortars. To work, the flares must be close enough to the target and at the proper height so the fighters can respond to a detailed target description. Another night technique is the use of long burning illumination marks (LOGs). Released from FAC or flare aircraft, LOGs drop to the ground and burn for 30 minutes. The LOG is then used as a reference to talk the pilots eyes on to the target.<27>

However, both these techniques require a low threat environment in order for the FAC or flare aircraft to accurately release the flare or LOG and to allow the fighter aircraft to loiter in the target area long enough for the pilot to respond to the target description. Flare or LOG delivery aircraft using these techniques in the high threat European environment would be extremely susceptible to enemy air defense threats.

Soviet doctrine for night operations also puts great emphasis on shooting down flares over their forces and placing flares of their own to illuminate opposing

troops.<28> An intense night battle with multiple flare use would not provide the opportunity for their employment in order to give the F-16 LANTIRN pilot an unmistakable uncompromised target mark. These marking techniques also give mobile targets the opportunity to disperse away from the flare or LOG position.

During night operations, targets can be distinctly, precisely and unmistakably marked by ground forces using electronic means. The laser designator is one available asset that can enhance target acquisition and identification for aircraft that are equipped with laser energy receivers known as laser spot trackers (LSTs). Ground forces mark the target with a laser designator and the LST receives the laser energy and provides the pilot with cockpit HUD steering to the reflected energy source. Laser designation is accomplished on a prearranged or briefed laser pulse code and the LST receiver is set on the same code to guarantee an uncompromised laser mark. The laser provides the most precise target mark available and can be used to distinguish "live" targets from friendly forces and decoys. <29> However, the Block 40 F-16 LANTIRN is not equipped with an LST or any other similar asset and is not currently programmed to receive one.<30>

Current physical means available to effectively and positively mark a target at night are extremely limited and

none appear to be compatible with the high speed low altitude night attack of the F-16 LANTIRN. Without a means to receive an electronic mark, the F-16 LANTIRN demonstrates an extremely limited capability to positively identify enemy targets at night in a troops-in-contact situation. With the limited capability of the FAC to control the final phases of the attack and without an effective means to positively mark the target, the only other possible alternative would be for the pilot to positively identify friendly troop positions in order to ensure he avoids them.

IDENTIFICATION OF FRIENDLY FORCES

Troop safety is a key consideration when employing close air support. The primary cause of friendly air attacks upon friendly troops is misidentifying friendly forces as enemy. Before completing an attack, the pilots must know the position of friendly forces.<31> Several means are available for identification of friendly troops; however, a close look must be taken to determine if they would be effective at night for the F-16 LANTIRN attack.

The number of techniques available for identifying friendly troops is also greatly reduced in the night environment. Colored smoke, signal mirrors and fluorescent panels are all ineffective at night. Devices such as flashlights or hand held strobes can be used, but these can

closely resemble ground fire and would have marginal success during a high speed low altitude attack.<32>

Signal lamps and other lighting equipment can also be used. But, to keep from drawing enemy attention and fire they must be aimed at the aircraft and that again would be virtually impossible due to the difficulty in acquiring the F-16 LANTIRN in the night attack. Flares, such as trip flares or 40mm illuminating grenades, fired in the air can be effective marks of friendly positions. However, these marks would usually be visible to the enemy as well and compromise friendly ground force positions.<33> As was the case for target marking, the F-16 LANTIRN has no electronic means to identify friendly ground force positions.<34>

This study shows that, as there was no accurate, precise, unmistakable means to mark the target for the F-16 LANTIRN night attack, it also appears that there is no effective positive way for the pilot to identify friendly forces without compromising their safety.

SUMMARY

Due to the nature of the mission, the ability of the F-16 LANTIRN pilot to conduct premission planning and target area study is extremely limited in the night CAS profile. The result is a heavy reliance on the mission planning, coordination and control accomplished by the forward air

controller. This mission data can be passed to the pilot by the TAC-A, but the procedure would be time intensive, must be accomplished in a low threat area and may result in data that is not accurate, entered in error, or not timely enough for mobile or unplanned targets. With the pilots restricted field-of-view in a task saturated environment, these limitations may severely degrade a night CAS attack.

Target acquisition will be complicated in the night CAS mission and the importance of the FAC to assist in acquisition or to ensure proper target identification becomes increasingly important. But, due to the F-16 LANTIRN attack profile which attempts to avoid detection, the ability of the FAC to provide positive final attack control is severely limited if not impossible.

As the FAC's ability to provide positive final control diminishes, initial target acquisition and accurate enemy and friendly troop identification by the attack pilot becomes increasingly important. Current procedures established for the control of attack aircraft during night CAS do not adequately address the situation where the FAC or ground forces are unlikely to acquire the fighter in the final attack phase.<35> However, Tactical Air Forces currently studying the issues are considering accomplishing final attack coordination by using electronic means (ie. ATHS) to provide accurate timely target data transfer to the

attack pilot and, if required, tasking the FAC to coordinate positive electronic target marking (ie. laser target designation).<36>

In the mean time, the current physical means to mark positions at night are marginally effective and subject to confusion or compromise and the F-16 LANTIRN posses no means of electronic data transfer or target identification. The inability to effectively accomplish these critical elements makes night air attack by the F-16 LANTIRN in support of troops-in-contact prohibitive.

The act of unintentionally placing fire on one's own troops is known as amicicide. The effects of air amicicide on friendly combat power can be devastating. Death and wounds, as well a confusion, which result from the attack of friendly troops by their own air forces, can and do have significant adverse effects on combat power, the progress of offensive operations, the viability of defensive positions and the morale and confidence of troops.<37>

A research study by Lt Col Charles L. Schrader reviewed the historical evidence of air amicicide during American armed conflicts. His study concluded that the incidence of air amicicide responds to three general factors: technological advances of aircraft which complicate the problem of adequately controlling the

placement of aerial fires; development of close air support doctrine which does not adequately consider the available identification and location technology; and in the final analysis, it is usually the result of human error that is not recognized in time.<38>

A review of the F-16 LANTIRN night attack characteristics lead one to conclude that it could easily result in air amicicide by one of those three factors. The night low altitude attack profile of the F-16 LANTIRN severely complicates the problem of adequate control for the placement of fires. Current close air support doctrine does not sufficiently address night employment with limited available identification and location assets. Also, any human error in the mission or final control phases could well result in the unintentional placement of ordnance on friendly troops without a means to stop it.

Flying at night is intensely challenging and can readily result in pilot task-saturation. Even F-111 crews, flying with two crew members to share the required tasks, will admit to the intense concentration and possible task-saturation that can result while flying in this environment. This is true even though the F-111 has a fully automatic terrain-following radar flight system and conducts night attacks only against thoroughly preplanned fixed targets.<39>

The F-16 LANTIRN pilot, manually flying single-seat in the night CAS environment, would be subjected to even greater challenges and a higher probability of total task-saturation. The night CAS mission would require attacking unplanned targets with information that can only be passed verbally and manually loaded by the single-seat pilot who must also continue to fly at night. It would require low level ingress and navigation through unplanned unfamiliar terrain without the ability to effectively reference a map. It requires attempting to survive by avoidance and defeat of the formidable integrated air defense threat while simultaneously attempting in minimum time to acquire targets that may or may not fall within the limited HUD or targeting pod FLIR field-of-view. And it must be done without any realistic direction or guidance available from the FAC.

The F-16 LANTIRN pilot would have to accomplish all this and, without the use of electronic marking equipment, still make a split-second decision whether the target he acquired was indeed enemy and not friendly. When all these factors are put together, the probability of task-saturation and ineffective or even tragic mission results can be realized.

Attempting to employ the F-16 LANTIRN in the night close air support mission would result in a severely limited night attack capability. The only reasonable success that

could be expected would be attacking targets that are not in close proximity to friendly force positions. And, this could be accomplished by an updated battlefield air interdiction profile. In the current configuration, the F-16 LANTIRN should not be employed in the night CAS role.

CHAPTER 5

ENDNOTES

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CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

This study evaluated the capability of the F-16 LANTIRN to accomplish the night close air support mission in Central Europe. The purpose of the study was to make a recommendation as to whether or not commanders should assign the F-16 LANTIRN pilot the night CAS mission. It is imperative for overall combat effectiveness that the decision consider the various unique aspects of night CAS.

In the process of evaluating the F-16 in the night CAS mission four areas have been addressed. This chapter summarizes those areas. The summary in each area is a generalization and the individual chapters should be referenced for specifics. After a review of the issues is made a final conclusion will be given. Finally, a look at future proposals will be made and recommendations for further study presented.

THE NIGHT CAS REQUIREMENT

Close air support is a significant part of the total offensive air support provided to ground forces by TACAIR. It provides the ground force commander the capability to deliver a wide range of weapons and massed firepower at decisive points. While battlefield air interdiction can

slow the tempo of reinforcements and support of the enemy offensive by operations that delay, disrupt or destroy forces in the deep battle, close air support can enhance friendly ground force operations by creating opportunities to break through enemy lines, protect the flanks of a penetration or prevent countermeasures to friendly maneuver by adding to fire support in the close battle.

Soviet doctrine professes that the combined-arms offensive once initiated must be developed continuously, day or night, throughout the depth of the battlefield until the ultimate goals have been attained. If we do not develop the capability to provide the full range of air support missions in the night battle, or if we choose to turn away from any of these missions, we can expect the Soviets to continue to emphasize and exploit the night environment.

The requirement for an effective night close air support capability to assist the ground force commander in the night battle is real.

THE NIGHT THREAT

Historical weather trends in Central Europe show that low clouds and visibilities are the norm more than the exception, especially, during the winter months when the hours of darkness are long. However, this weather threat is significantly reduced with the capability to fly at very low

altitude at night. The F-16 LANTIRN has demonstrated that capability which opens a window for operations that would not otherwise be available.

The Soviet integrated air defense system employed in Central Europe is indeed formidable. The number of air defense weapons that make up that system are a significant threat to any air operations over Soviet ground forces. However, by reducing or removing the effectiveness of many of the air defense systems by flying a very low altitude at night, the F-16 LANTIRN has a realistic chance to operate against this formidable threat.

It appears that the F-16 LANTIRN has a realistic opportunity to operate in the night close battle environment in spite of the Central European weather and Soviet integrated air defense threat.

F-16 LANTIRN NIGHT GROUND ATTACK

The LANTIRN system gives the F-16 pilot an effective fundamental night low altitude attack capability. The navigation pod's terrain-following radar and wide field-of-view FLIR sensor enable the pilot to fly and deliver weapons at night under the weather at very low altitudes. The targeting pod provides, within limitations, an added sensor for improved conventional weapon delivery, an enhanced IIR Maverick capability and even a limited LGB capability.

However, the system also has definite limitations that cannot be overlooked. Mission planning is critical and must consider and predict the infrared signature of selected turn points and targets. Attack profiles are limited to a direct approach and target acquisition through the HUD is restricted to a 28 degree wide field-of-view. Target information must be precise and timely and the navigation system must be accurate to ensure the target falls inside the navigation or targeting pods' FLIR field-of-view.

After reviewing the system, it appears that the F-16 LANTIRN gives the tactical air force a good fundamental low-level night ground attack capability, but with some definite and specific limitations in the CAS fight.

F-16 LANTIRN IN THE CAS MISSION

Due to the ever changing close battle and the responsiveness required in the close air support mission, the opportunity for the F-16 LANTIRN pilot to do premission planning and target area study is limited at best. Planning and target data passed by the FAC or TAC-A becomes much more critical to mission success. However, receiving and applying this data is a time-intensive task. It must be accomplished by the F-16 LANTIRN pilot in a highly demanding task-saturated environment which is conductive to pilot induced errors. This combination of factors may well mean

marginal or even tragic results against unplanned or moving targets in the close battle.

Current close air support procedures rely heavily on the ability of the FAC to visually acquire the attacking fighter aircraft in order to provide effective final control. However, in the night environment, the ability of the FAC to acquire the F-16 LANTIRN on a high speed low-level attack profile is virtually impossible. Without FAC assistance, the ability of the F-16 LANTIRN pilot to acquire targets within the limitations of the FLIR field-of-view is greatly reduced and the ability of the FAC to abort an attack "gone wrong" is severely limited.

Finally, the ability of the F-16 LANTIRN pilot to positively and accurately identify and distinguish enemy targets from friendly troops becomes critical. But, the current physical means to mark positions at night are ineffective in a high threat attack and the F-16 LANTIRN has no means of electronic target identification. The result is an inability of the F-16 LANTIRN to effectively provide close air support to troops-in-contact.

CONCLUSION

The need for a night close air support capability is significant. A 24 hour battle will make a night requirement no less important than in day. The LANTIRN system does give

the F-16 pilot a basic night, low altitude ground attack capability that was previously unavailable. It can also be concluded that the F-16 LANTIRN has a reasonable chance of survival in the Central European weather and integrated air defense threat environment.

However, with the limited means of target data transfer, the inability of the FAC to provide effective final attack control and the lack of a means for the pilot to positively and unmistakably acquire and identify target and/or friendly troops coupled with the task-saturated nature of the night low altitude weather environment, air attack at night by the F-16 LANTIRN in support of troops-in-contact is prohibitive. In the current configuration, the F-16 LANTIRN should not be employed in the night CAS mission in Central Europe.

RECOMMENDATIONS

Reviewing the issues presented, one could also conclude that the F-16 LANTIRN does have a capability to attack targets if they are not in close proximity to friendly positions. If the TACP planners can guarantee that an air attack against these targets of interest would not risk friendly troop positions, then the F-16 LANTIRN could be assigned the mission.

This study recommends that those targets that are

not in the vicinity of troops-in-contact be assigned to F-16 LANTIRN pilots that have been tasked for battlefield air interdiction. This type of attack can be accomplished if the pilot is directed in the ATO to proceed to a contact point and receive updated target information from the TAC-A. This employment of the F-16 LANTIRN could aid the ground commander in his night battle yet not risk the safety of his combat forces.

FUTURE EMPLOYMENT

Many systems have been recommended for upgrade in future F-16 aircraft. Several of these systems could have significant impact on the success and future employment of the F-16 in the night CAS mission.

One upgrade under consideration for future F-16s is the addition of an automatic target hand-off system (ATHS). ATHS is a data transfer system that facilitates air-to-air or ground-to-air communications. Instead of using voice communications, ATHS uses digital data bursts to minimize the effects of jamming, reduce enemy detection, and aid in the accuracy of data transfer.<1> A system of this type could significantly increase the capability of the F-16 pilot in receiving and applying timely target information given by the TAC-A, FAC or ground agencies.

Another system under consideration is Pave Penny, a

laser spot tracker (LST). Currently used on A-7 and A-10 aircraft, the Pave Penny assists the pilot in acquiring targets at greater distances and in camouflage situations.<2> A highly accurate system, the Pave Penny could be critical to an F-16 capability to correctly identify enemy targets in a night attack profile.

Instead of the current LANTIRN attack system being employed on future F-16s for night CAS, a modified FLIR capability called Falcon Eye is being proposed. Falcon Eye is a head steered FLIR system that projects the video on the pilot's helmet visor instead of the HUD and presents a movable field-of-view slued to the helmet position for wider target area coverage and acquisition.<3>

Current Air Force proposals are considering these systems for incorporation into Block 50 F-16s and to retrofit 146 Block 30 F-16s to meet future night CAS requirements. Current proposals do not address upgrading Block 40 F-16 LANTIRN aircraft with any of these systems.<4> My recommendation is that Block 40 F-16 LANTIRN aircraft not be employed in the night CAS mission in Central Europe and that future Block 50 or retrofit Block 30 F-16s with these upgrade systems incorporated be considered instead.

Future studies that assess the night close air support mission should address the added capabilities these

proposed systems give to the F-16 pilot and also if these new capabilities adequately address the issues of command and control of night ground attack in support of troops-in-contact.

CHAPTER 6

ENDNOTES

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